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3. **Introduction** – State the purpose of the article and summarize the rationale for the study or observation.

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Research Article

Serum Protein Levels as Potential Biomarkers in Oral Cancer and Oral Precancer

Vibhuti Shreesh Mhatre[1], Snehal N Dhumal[2], Shilpa Nandvanshi[3], Prathmesh Tukaram Patil[3], Sheetal Choudhari[3]

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ABSTRACT:

Background: The reactive free radicals may interact with intracellular macromolecules such as proteins leading to carcinogenesis. This study was conducted to assess the use of proteins as potential biomarkers in oral premalignant and malignant lesions.

Materials & Methods: This study was conducted on 15 individuals with oral potentially malignant disorders, 15 patients with oral cancer, and 15 healthy controls.

Results: Our results showed that serum protein levels were decreased in OPMDs, but increased in Oral cancer.

Conclusion: It may be concluded that serum protein can be used a potential biomarker for Oral precancer and oral cancer.

KEY WORDS: OPMDs, Oral cancer, leukoplakia, OSMF, biomarkers

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Submitted: 01.07.2024, **Accepted:** 10.11.2024, **Published:** 14.12.2024

INTRODUCTION:

Oral cancer is the 6th most common cancer in the world with a 5-year mortality rate of about 50%. Delayed detection is likely to be a primary reason for the high mortality rate of oral cancer patients.[1] Detection of cancer at the early stage is of utmost importance to decrease the morbidity and mortality of the disease. Hence, there is an imperative need of a sensitive biomarker to improve early detection of oral cancer[2].

Oral cancers are generally preceded by Oral Potentially Malignant Disorders (OPMDs) like Oral Leukoplakia, OSMF, etc. During oncogenesis, various biochemical alterations occur at every stage, during which, various substances change quantitatively in the serum and are collectively termed as tumour markers or serum biomarkers[3].

Serum biomarkers are defined as substances changing quantitatively in the serum during tumour development[4]. The biochemical markers may provide evidence of the changes taking place in the body at a time whenever changes at tissue and cellular level are not obvious to be taken as an evidence of frank malignancies[5]. Many biochemical substances deviate from their normal values; these may include proteins of body fluid. Measurement of total protein concentration provides general information, reflecting disease states in many organs systems, so alternation in serum total protein concentration is used commonly in clinical practice as an indicator for underlying disease or monitoring disease activity[6]. Hence, we carried out the present study with an aim to estimate serum proteins levels in oral precancer and oral cancer patients and in

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Table 1: Master chart.

Case Number	Age/Sex	Habits	Provisional Diagnosis	Serum protein levels (g/dl)
1	55/F	Tobacco	Leukoplakia	3.93
2	24/M	Tobacco, Gutkha	OSMF+ Leukoplakia	4.33
3	44/F	Mishri	Leukoplakia	2.7
4	60/M	Smoking	Initial leukoplakia	2.23
5	55/M	Tobbaco , smoking, Gutkha chewing	OSMF	4.09
6	19/M	Smoking	Smokers palate, tobacco pouch kerstosis	4.10
7	39/F	Tobacco, Gutkha	OSMF	6.45
8	25/M	Tobacco	Leukoplakia	4.24
9	41/F	Tobacco	Leukoplakia	3.3
10	50/M	Mishri	leukoplakia	3.44
11	70/F	Tobacco	melanosis	3.52
12	60/M	Mishri	LESION	2.27
13	60/M	Tobacco	Pre leukoplakia	2.9
14	65/M	Bidi	Lichenoid reaction	3.93
15	29/M	Tobacco	Lichenod reaction	4.25
16	25/F	None	Normal	5.88
17	27/F	None	Normal	6.11
18	26/F	None	Normal	2.8
19	63/M	None	Normal	5
20	68/M	None	Normal	7.17
21	33/M	None	Normal	1.85
22	36/F	None	Normal	3.60
23	34/M	None	Normal	3.67
24	29/M	None	Normal	4.36
25	25/F	None	Normal	1.78
26	32/M	None	Normal	4.12
27	54/F	None	Normal	3.41
28	45/M	None	Normal	4.27
29	41/F	None	Normal	3.8
30	51/M	None	Normal	4.01
31	72/F	Mishri	CA	4.78
32	55/M	Tobacco, Gutkha	CA	13.9
33	63/M	Tobacco	CA	5.7
34	48/F	Tobacco, Mishri	CA	7.6
34	33/F	Gutkha	OSMF CA	7.2
36	34/M	Tobacco	CA	4.4
37	28/M	Tobacco, Mishri	CA	4.77
38	59/M	Tobacco	CA	5.19
39	69/M	Mishri	CA	3.99
40	36/M	Tobacco	CA	6
41	49/M	Bidi	CA	4.12
42	45/M	Tobacco	CA	6.5
43	54/M	Gutkha	CA	9.1
44	28/M	Tobacco, Gutkha	OSMF CA	8.03
44545	59/M	Tobacco	CA	6.56

healthy controls to evaluate their role in diagnosis and prognosis of oral cancer.

MATERIALS & METHODS:

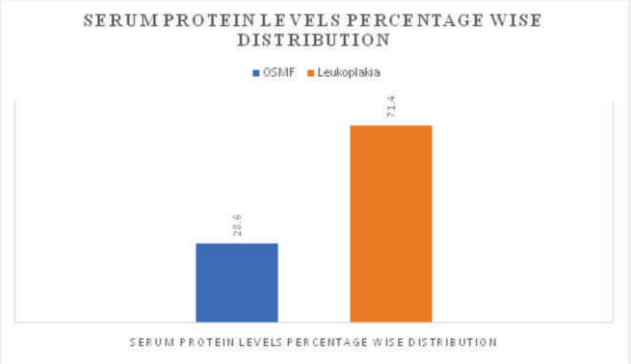
The prospective study was carried out in the Department of Oral Pathology & Microbiology of our institute. After obtaining Institutional ethical clearance and written informed consent from the patients, 5 ml of blood was aspirated from right/left antecubital vein and was centrifuged at 2000 rpm for 10 minutes to separate

Table 2: Descriptive statistics.

	Serum Protein Levels			95% confidence interval to the mean		Minimum	Maximum
	Mean	Standard deviation	Standard error	Lower bound	Upper bound		
Normal (n=15)	4.20	1.73	0.522	3.03	5.31	1.78	7.17
OPMDs (n=15)	4.08	0.95	0.25	3.52	4.63	2.27	4.63
OSCC (n=15)	5.31	2.84	0.76	3.66	6.95	3.01	13.90

the serum. The serum was then analysed for total proteins. Assessment of serum total protein was done using the Biuret method with absorption at 540 nm. Serum total proteins were expressed as g/dL. Only patients with histopathological diagnosis were considered. Patients with systemic diseases and those with a follow-up of oral precancer or oral cancer and past history of surgery were excluded. The study subjects were divided into 3 groups- 15 healthy controls, 15 individuals with OPMDs, and 15 patients with oral cancer. Participants from age group 25-60 years from same socioeconomically condition were included in the study.

Graph 1: Percentagewise distribution of serum proteinlevels between OSMF and Leukoplakia patients.



RESULTS:

The serum protein levels were estimated in all three groups and tabulated (Table-1). The statistical difference was analyzed by using one-way ANOVA test. The mean value of total protein was minimum (4.08±1.73) g/dl in the OPMD group and was maximum (5.31±2.84) in the oral cancer group (Tables-2 & Table 3). Percentage-wise comparison of proteins in OSMF and leukoplakia patients showed that OSMF patients had decreased serum protein levels as compared to leukoplakia patients (Graph- 1).

Table 3: Mean Rank by Kruskal-Wallis test.

Groups	Serum protein values - Mean Rank
Normal (n=15)	6.0
OPMDs (n=15)	7.5
OSCC (n=15)	7.5

DISCUSSION:

The free radicals are said to be highly reactive and short-lived and are known to be involved in the process of carcinogenesis[5]. Free radicals in high concentrations interact with intracellular macromolecules such as DNA, proteins, carbohydrates, and lipids, initiating and promoting carcinogenesis. Free radicals attack the body's healthy cells, leading to loss of structure and function. In carcinogenesis, increased oxidative stress and weakened antioxidant defense produce damage to the macromolecules like proteins. Thus, proteins can be potential biomarkers in oral premalignant and malignant lesions[7]. Oxidation of proteins plays an important role in the pathogenesis of cancer. Previous studies have demonstrated decreased protein levels in the cases of OPMDs and oralmalignancies[8]. In oral cancer, tobacco and areca nut chewing are the main etiologic factors leading to tissue damage and resultant free radicals play a major role as carcinogens.

Our results showed that serum protein levels were decreased in OPMDs, but increased in Oral cancer. Our results were consistent with the results of More CB et al in OSMF and Oral leukoplakia patients (OPMD), Ahmad S et al, Patidar KA et al, and Rajendran R et al, in OSMF patients (OPMD) and Dawood RM et al, in oral cancer patients[2,7,8,9,10]. But our results were not consistent with the results of Chandran V et al, in the Oral cancer group in which the plasma protein levels were found to be decreased[11]. The increased serum protein levels may be associated with inflammatory reactions associated with oral malignancy. One of the reasons for the decrease in total proteins in oral precancer patients is a decrease in serum albumin level and the other reason is tobacco's effect on the liver which results in a reduction in the synthesis of protein and ultimately total protein level decreases[8]. Due to reduced mouth opening in OSMF patients, there

is a reduced overall intake of food leading lack of nutrients which may be responsible for reduced serum protein levels in OSMF patients.

CONCLUSION:

The present study showed decreased serum protein levels in OPMDs, but increased serum protein levels in oral cancer. It may be concluded that serum protein can be used a potential biomarker for Oral precancer and oral cancer.

Financial Support and Sponsorship
Nil.

Conflicts of Interest
There are no conflicts of interest.

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Research Article

Oral Manifestation in Gastro-Oesophageal Reflux Disease - A Short Study

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ABSTRACT:

Background: Gastroesophageal reflux disease is a common condition that results from the reflux of gastric material through the lower esophageal sphincter into the esophagus or oropharynx. The aim of the present study was to assess oral manifestations in gastero-oesophageal reflux disease by endoscopy.

Materials & Methods: The prospective study was carried in the department of Oral Medicine & Radiology. The study group consisted of 50 patients with Gastroesophageal reflux disease. The presence/absence of various indicators was evaluated for each patient.

Results: We observed that sensitivity and halitosis were most prevalent while tooth wear was least observed. In our study we found halitosis was found in more than 90% of cases.

Conclusion: In conclusion, our study suggests that Xerostomia is a significant clinical symptom of GERD patients and erythema of soft palate/uvula, tooth wear is significant clinical sign of GERD patients.

KEY WORDS: GERD, xerostomia, halitosis, erythema

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INTRODUCTION:

Gastroesophageal reflux disease (GERD) is a common condition that results from the reflux of gastric material through the lower esophageal sphincter (LES) into the esophagus or oropharynx, causing symptoms and/or injury to esophageal tissue. While heartburn and acid regurgitation may be the most commonly reported symptoms of GERD, they are not the only associated symptoms[1]. Approximately one third of the population in industrialized countries has occasional or continues upper gastrointestinal disorders. One fourth of these patients with symptoms seek medical help, and about half of these have dyspeptic symptoms[2]. Gastroscopy examination for patients with upper gastrointestinal disorders is used. According to modern medical practice; the annual need for Gastroscopy is one per 100 inhabitants[3,4]. Thus gastrointestinal disorders are important from an epidemiological point of view and we being oral physicians must be aware of their consequences in the mouth. And vice-versa if the dentist observes signs and symptoms in the mouth that may have been caused by an underlying disease such as Gastroesophageal reflux disease, the early referral of the patient to a gastroenterologist and early treatment given may prevent the later complications like premalignant and malignant conditions of oesophagus[5]. The most common symptoms often present are heartburn, regurgitation of gastric contents into the mouth, dysphagia, blood loss if the esophgeal erosion and ulcers, and asthma-like symptoms and chronic cough if refluxed material is spilled into the larynx and tracheobronchial tree[6].

From dental point of view oral manifestations

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such as dental erosions because of regurgitation of gastric contents which may be below pH 1, halitosis, non-specific burning sensation, mucosal ulceration/ erosion, loss of taste both xerostomia and increased salivary floware observed[7].

The aim of the present study was to assess oral manifestations in confirmed patients with gastero-oesophageal reflux disease by endoscopy.

MATERIALS & METHODS:

The prospective study was carried in the department of Oral Medicine & Radiology of our institute. The study had institutional ethical committee clearance. The participants were informed about the study and an informed consent was obtained from each participant. The study group consisted of 50 patients with GERD. Patients with other systemic diseases and those undergoing treatment were excluded. All the patients had undergone endoscopy and were diagnosed as GERD by an experienced gastroenterologist. A thorough oral and dental examination was performed using mouth mirror and probe and sufficient light. The presence/absence of the indicators was evaluated for each patient. These included signs & symptoms such as xerostomia, sensitivity, halitosis, Soft/hard palate erythema and tooth wear. Chi-square test statistical analysis was done.

RESULTS:

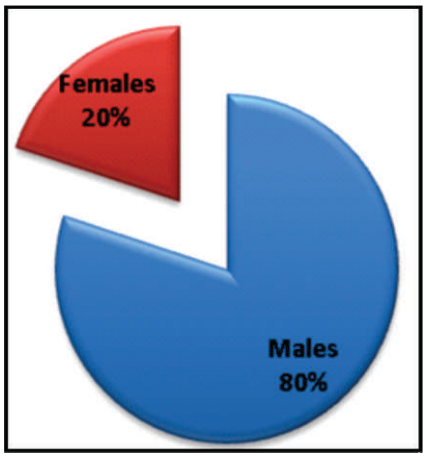
The results were tabulated and following observations were done. In our study 40 participants were males and 10 were females (Graph 1). Most of the patients were within the age group of 30 to 60 years (n=27) (Graph 2). Only 7 patients were more than 60 [Table 1]. We observed that sensitivity and halitosis were most prevalent (n=44) but the values were not significant. Tooth wear was least observed (n=05).

Table 1: Age distribution among the participants.

Age (yrs)	Count	%
<30	16	32
30-60	27	54
>60	7	14

In our study we found xerostomia symptom statistically significant (0.003) while halitosis was found in more than 90% of cases. Soft palate/uvula erythema which was clinical sign was statistically significant in our study. In the present study, tooth wear was statistically significant, while sensitivity was not statistically significant (Table 2; Graph 3).

Graph 1: Distribution of gender.



Graph 2: Distribution of age.

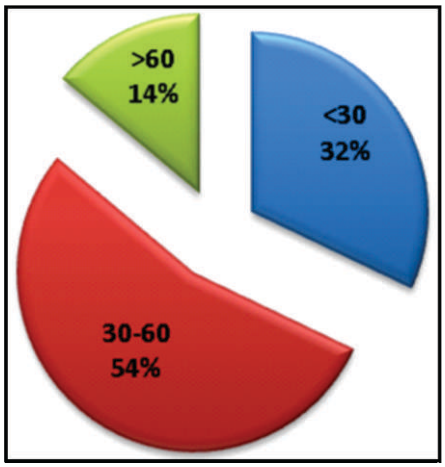


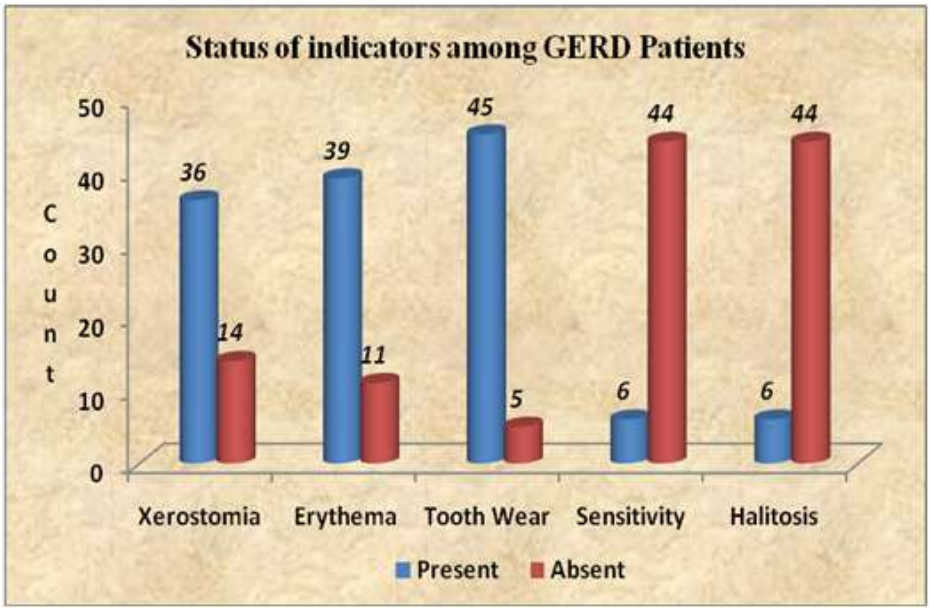
Table 2 : Prevalence of indicators among the participants.

Indicators	Present	Absent	*p*-value
Xerostomia	14	36	0.003
Erythema	11	39	0.000
Toothwear	05	45	0.000
Sensitivity	44	06	Not significant
Halitosis	44	06	Not significant

DISCUSSION:

There is a close correlation between GERD and oral cavity diseases as it is recognized by gastroenterologists and other specialists[7]. In 1933, Bodecker noted a relationship between gastrointestinal alterations and dental erosion; his thought was shared by Bargen and Austin in 1937 and two years later by

Graph 3: Status of indicators among GERD Patients.



Holst and Lange[8-10]. In 1971, Howden et al. reported that dental erosions may lead to the diagnostic suspect of acid reflux in patients with silent GERD[11]. Regurgitation of gastric acid into mouth leads to tooth erosion and has been observed in a number of studies[2,3,5,12] **.** The erosion determined by gastric reflux is typical because the lingual and occlusal surface of the posterior teeth is affected, as confirmed by some studies[12-13]. The damaged teeth are the mandibular molars of the primary and permanent dentition. This kind of erosion is different from the vomiting caused by bulimia because it involves the lingual surfaces of mandibular incisors. It also differs from the erosion caused by acids coming from extrinsic source, in which it is possible to note damage to the labial surfaces of the anterior teeth with a decreasing severity in the posterior area. In cases of chronic vomiting, bulimia and anorexia there is no doubt that gastric acid reaches the oral cavity and possibly causes erosion but these are rare clinical entities compared with the commonly occurring acid Gastroesophageal reflux that is frequently mentioned as a causal factor in erosion. Järvinen et al. underline the presence of burning mouth, aphthoid lesions and hoarseness in patients with disorders of the upper digestive tract[14]. Halitosis was most prevalent and it is attributed to volatile sulphur compounds produced by oropharyngeal bacteria[15]. Halitosis was not statistically significant which is also finding according to devault KR (2005)[16].

In our study we found xerostomia statistically significant which is in accordance with other studies[14,17,18]. Soft palate/uvula erythema which was clinical sign was statistically significant in our study and was in accordance with other studies[17,19].

Erythema of the soft palate and uvula, glossitis, epithelial atrophy, xerostomia could be common in GERD patients. However, the mucosal changes described are quite common and not pathognomonic and specific of GERD patients. In fact a careful differential diagnosis should be made with oral candidiasis, Sjögren syndrome, and changes in salivary flow, drug-related xerostomia and oral lesions induced by smoking. Moreover, dietary changes and poor oral hygiene can cause lesions similar to those induced by acid reflux. The association between oral mucosal manifestations, enamel erosions and the patient's symptoms should induce the dentist or the general practitioner towards the suspected diagnosis of GERD. We observed that, dental erosion may be seen in severe Gastroesophageal reflux disease of long duration. Moreover, not all patients with reflux disease develop erosion.

CONCLUSION:

In conclusion, our study suggests that Xerostomia is a significant clinical symptom of GERD patients and erythema of soft palate/uvula, tooth wear is significant clinical sign of GERD patients. Keeping in mind these clinical signs and symptoms, as oral physians, we can advice patients to consult gastroenterologist for treatment of GERD so that we can prevent the further complications of GERD. However, further studies need to be done with larger samples.

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Conflicts of Interest
There are no conflicts of interest.

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Research Article

Addressing Problems of Oral Pathology Students after Improving Teaching Learning Methods

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ABSTRACT:

Background- Oral Pathology and Oral Histology as academic subjects is concerning. Despite significant advancements through books, the internet, and conferences, gaps remain in students' understanding and interest in these fields. This may partly stem from the perception that these are non-clinical subjects with limited practical career opportunities. We thought of introducing latest teaching and learning methods to improve the students understanding and make it more interesting.

Materials& Methods- The cross-sectional questionnaire based study was done with BDS students, to gauge the understanding of their knowledge in the subject of Oral Pathology and Oral Histology after introduction of advanced teaching learning methods. There were 15 multiple choice questions. The data recorded was analyzed using frequency distribution.

Results- There were very positive results with new methods and it was evident in the understanding of the subject by the students.

Conclusion-Our study revealed that students generally have a good overall understanding of Oral Pathology. However, they do face certain challenges that can be easily addressed with appropriate measures. Through this research, we aim to raise awareness among readers about the evolving trends in teaching learning and encourage their regular incorporation into practice.

KEY WORDS: Game based learning, information technology, gamification, puzzles in teaching, competency based learning.

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INTRODUCTION:

Dentistry is a 4 year under-graduate program (excluding internship). Oral Pathology is a basic subject that is taught in second and third year. This subject forms the basis of all the other subjects[1]. Continuous assessment is important and has been useful in teaching learning amongst dental students. This practice has been since decades[2]. Most of the dental institutes still rely on old teaching learning methods like lectures, practical, seminars, etc. With the advent of numerous online platforms, Artificial Intelligence (AI), gaming technologies, etc, teaching & learning for oral pathology can be improved to make it more student centric[3]. On an average, 100 students are there in 1 professional year and each student has his/her own capacity to grasp and understand a subject. The foundation of dental students' education lies in their ability to recognize pathological diseases through microscopic examination[4]. This can be accomplished by studying books, dental literature, regularly viewing slides and adhering to the prescribed curriculum. The combination of theoretical understanding and practical skills is commonly referred to as knowledge. Rather

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Table 1: Questionnaire for BDS third year students after introduction of improved teaching learning methods.

Demographic details:					
Gender:	Male	Female			
Academic Session:	2021 -22	2022 -23			
Questionnaire:					
1.How many hours do you study oral pathology in a day? (including classes in institute)	(a)less than 1 hour	(b) 1 hour to 3 hours	(c) 3 hours to 5 hours	(d) more than 5 hours	
2. Do you attend lectures or read books which discuss slides before they are shown?	(a) Yes	(b) No			
3, Do you ask your teachers to explain, in case of difficulties?	(a) Yes	(b) No	(c) Sometimes		
4. Can online classes replace ofline classes?	(a) Yes	(b) No			
5. Are you aware of the following? (Please tick 1 or more)	(a) Flipped classroom	(b) Gaming in teaching learning	(c) Competency based learning	(d) Collaborative learning	
6. Does the department use gamification for teaching learning?	(a) Yes	(b) No	(c) Sometimes		
7. Are smartboards used for teaching?	(a) Yes	(b) No	(c) Sometimes		
8. Which gamification platform is most beneficial? (Please tick 1 or more)	(a) Kahoot	(b) Crosswordlabs	(c) Puzzle. org	(d) Others	
9. If your answer to the above question is ***Others***, please specify the platform					
10. Have you been guided to make videos of lesions?	(a) Yes	(b) No			
11. Do you refer to youtube channel for teaching learning?	(a) Yes	(b) No			
12. Have you used in mobile applications for teaching learning?	(a) Yes	(b) No			
13. Do you feel the difference in your performance after using games and Information Technology for teaching learning?	(a) Yes	(b) No	(c) Not sure		
14. Do you feel motivated?	(a) Yes	(b) No	(c) Sometimes		
15. According to you, gamification has helped to promote which of the following? (You may tick more than 1)	(a) concentration	(b) memory retention	(c) engagement	(d) team spirit	(e) progress tracking

than addressing it later, it is crucial to develop positive attitudes toward dental health promotion during one's time as a student[5]. Information technology (IT)has its use in almost all fields of education. Various online platforms, gaming applications have been explored for dental subjects[6]. We planned the curriculum of third year dental students with the introduction of AI, games, puzzles along with their lecture, practical and seminar. This attempt was made to reinforce our belief that IT can act as a catalyst and improve students performances.

MATERIALS & METHODS:

A descriptive cross-sectional closed ended questionnaire based survey was conducted in the department of Oral & Maxillofacial Pathology of our institute. The study had the approval of the research advisory committee. The prepared questionnaire was distributed to all the undergraduate students after they completed their BDS 3rd year. We included the students of 2 academic sessions (Group-I & Group-II). The study's goals were explained to every participant. Each respondent received the questionnaire and was asked to complete it anonymously. A total of 196 students formed the study group. An informed consent was received from all the participants. The students were provided with the questionnaire containing multiple choice questions (MCQs) [Table 1]. It was structured to be straightforward and easy to understand and respond to. The design was pre-tested for accuracy, validity, consistency, and the clarity of the questions. The questions comprised of relevant alternatives. The identity of the participants was kept anonymous. The data recorded was analyzed using frequency distribution.

RESULTS:

All the 196 participants responded to the questionnaire. There were 98 students in each academic session. In total, 36 were males and 160 were females, highlighting a predominance of females. Most of the students (63.77 %) study oral pathology as a course for 3 to 5 hours in a day. 67.34 % students confirmed that they read text before attending practical classes. Almost half the students ask their teachers to explain in case of difficulties. 79.08 % students were aware of gaming in teaching learning, while only 27.55 % knew about competency based learning. 59.18% participants said that smartboards were used. Kahoot (89.2%) and crosswordlabs (90.30%) were most commonly used in teaching learning in the institute. 90.81% of students were guided to make videos for learning. 98.46% students confirmed that they use youtube channel and 94.38% admitted that they use some mobile application for learning. 86.22% responded that gamification and IT made positive difference in their learning. Around 93.87% students said that their progress tracking is the best outcome of these innovations. The results were not statistically significant. Table 2 describes the overall responses to the answers of the questionnaire.

DISCUSSION:

The prospective study was an attempt to get firsthand knowledge from the students about their opinion on using IT, AI and various online platforms in teaching learning oral pathology. The participants believed that reading texts before classes helps them a lot. Moreover, around 70 % students sometimes or frequently ask the teachers to explain in case of difficulty and they confirmed that this arose interest in the subject. Similar finding was also seen in other studies[7]. Most of the students were aware of gamification in oral pathology. Almost 98.46 % students confirmed that although games and online platforms give leverage for good learning, offline classes are necessary. This has also been found in various other studies[8]. Competency based learning, flipped classroom and collaborative learning scored less compared to gamification. Around 89.28 % students accepted that knowledge assimilation and memory retention can be enhanced by platforms like Kahoot and crosswordlabs. Similar findings were also seen in other studies. We searched pubmed and could not find crosswordlabs use in oral pathology teaching [9,10,11]. The students refer to few youtube channels, such as Oral Pathology Ready Reckoner and mobile app for learning[6,12,13]. The use of online teaching may be an effective method of providing meaningful insights for undergraduate dental students[14]. There was a very strong and positive correlation between use of IT and dental education. Various attributes such as concentration, memory retention, engagement, team spirit and progress tracking are addressed by innovative teaching learning methods. To sum up, online platforms do have a positive impact on teaching and learning and influence modern learning.

CONCLUSION:

Our study revealed that students generally have a good overall understanding of Oral Pathology. However, they do face certain challenges that can be easily addressed with appropriate measures.

Table 2: Overall responses to the Questionnaire

Questions	Answers	I N (%) out of 196	II N (%) out of 196	Total N (%) out of 196
1.How many hours do you study oral pathology in a day? (including classes in institute)	(a)less than 1 hour	10 (5.10 %)	09 (4.59 %)	19 (9.69 %)
	(b) 1 hour to 3 hours	15 (7.65 %)	17 (8.67 %)	32 (16.32 %)
	(c) 3 hours to 5 hours	64 (32.65 %)	61 (31.12 %)	125 (63.77 %)
	(d) more than 5 hours	09 (4.59 %)	11 (5.61 %)	20 (10.20 %)
2. Do you attend lectures or read books which discuss slides before they are shown?	(a) Yes	63 (32.14 %)	69 (35.10 %)	132 (67.34 %)
	(b) No	35 (17.85 %)	29 (14.79 %)	64 (32.65 %)
3, Do you ask your teachers to explain, in case of difficulties?	(a) Yes	46 (23.46 %)	52 (26.53 %)	98 (50 %)
	(b) No	32 (16.32 %)	28 (14.28 %)	60 (30.61 %)
	(c) Sometimes	20 (10.20 %)	18 (9.18 %)	38 (19.38 %)
4. Can online classes replaceofline classes?	(a) Yes	02 (1.02 %))	01 (0.51 %)	03 (1.53 %)
	(b) No	96 (48.97 %)	97 (49.48 %)	193 (98.46 %)
5. Are you aware of the following? (Please tick 1 or more)	(a) Flipped classroom	32 (16.32 %)	40 (20.40 %)	72 (36.73 %)
	(b) Gaming in teaching learning	75 (38.26 %)	80 (40.81 %)	155 (79.08 %)
	(c) Competency based learning	24 (12.24 %)	30 (15.30 %)	54 (27.55 %)
	(d) Collaborative learning	30 (15.30 %)	40 (20.40 %)	70 (35.71 %)
6. Does the department use gamification for teaching learning?	(a) Yes	75 (38.26 %)	80 (40.81 %)	155 (79.081 %)
	(b) No	10 (5.10 %)	08 (4.08 %)	18 (9.18 %)
	(c) Sometimes	13 (6.63 %)	10 (5.10 %)	23 (11.73 %)
7. Are smartboards used for teaching?	(a) Yes	56 (28.57 %)	60 (30.61 %)	116 (59.18 %)
	(b) No	34 (17.34 %)	31 (15.81 %)	65 (33.16 %)
	(c) Sometimes	08 (4.08 %)	07 (3.57 %)	15 (7.65 %)
8. Which gamification platform is most beneficial? (Please tick 1 or more)	(a) Kahoot	85 (43.36 %)	90 (45.91 %)	175 (89.28 %)
	(b) Crosswordlabs	84 (42.85 %)	93 (47.44 %)	177 (90.30 %)
	(c) Puzzle. org	54 (27.55 %)	43 (21.93 %)	97 (49.48 %)
	(d) Others	05 (2.55 %)	07 (3.57 %)	12 (6.12 %)
9. If your answer to the above question is ***Others***, please specify the platform				
10. Have you been guided to make videos of lesions?	(a) Yes	88 (44.89 %)	90 (45.91 %)	178 (90.81 %)
	(b) No	10 (5.10 %)	08 (4.08 %)	18 (9.18 %)
11. Do you refer to youtube channel for teaching learning?	(a) Yes	96 (48.97 %)	97 (49.48 %)	193 (98.46 %)
	(b) No	02 (1.02 %)	01 (0.51 %)	03 (1.53 %)
12. Have you used any mobile applications for teaching learning?	(a) Yes	90 (45.91 %)	95 (48.46 %)	185 (94.38 %)
	(b) No	08 (4.08 %)	03 (1.53 %)	11 (5.61 %)
13. Do you feel the difference in your performance after using games and Information Technology for teaching learning?	(a) Yes	84 (42.85 %)	85 (43.36 %)	169 (86.22 %)
	(b) No	03 (1.53 %)	02 (1.02 %)	05 (2.55 %)
	(c) Not sure	11 (5.61 %)	11 (5.61 %)	22 (11.22 %)
14. Do you feel motivated?	(a) Yes	90 (45.91 %)	94 (47.95 %)	184 (93.87 %)
	(b) No	01 (0.51 %)	00 (0 %)	01 (0.51 %)
	(c) Sometimes	07 (3.57 %)	04 (2.04 %)	11 (5.61 %)
15. According to you, gamification has helped to promote which of the following? (Please tick 1 or more)	(a) concentration	85 (43.36 %)	87 (44.38 %)	172 (87.75 %)
	(b) memory retention	75 (38.26 %)	80 (40.81 %)	155 (79.08 %)
	(c) engagement	80 (40.81 %)	85 (43.36 %)	165 (84.18 %)
	(d) team spirit	79 (40.30 %)	88 (44.89 %)	159 (81.12 %)
	(e) progress tracking	91 (46.42 %)	93 (47.44 %)	184 (93.87 %)

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Conflicts of Interest
There are no conflicts of interest.

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Review Article

A Review-Obstructive Sleep Apnea

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ABSTRACT:

Obstructive sleep apnea (OSA) is characterized by recurrent episodes of partial or complete collapse of the upper airway during sleep, resulting in reduced or absent airflow lasting for at least 10 seconds and associated with either cortical arousal or a fall in blood oxygen saturation. OSA is associated with major comorbidities including daytime somnolence, impaired cognition, poor quality of life. OSA is an independent risk factor for a variety of cardiovascular diseases such as hypertension, atrial fibrillation, etc. Specialized diagnostic modalities include CBCT, CT, MRI, cephalometry. The gold standard is polysomnography. Management include behavioral modification, weight loss, medication, continuous positive airway pressure, oral appliance therapy, and surgical procedures. This article briefly describes the pathophysiology and its effects on the day to day life, various diagnostic modalities and management of OSA.

KEY WORDS: Lasers, Dentistry, laser efficiency, patient care, laser application

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INTRODUCTION:

Recurrent episodes of partial or total collapse of the upper airway during sleep, resulting in decreased (hypopnea) or absent (apnea) airflow lasting for at least 10 seconds, are the hallmark of obstructive sleep apnea (OSA). These episodes are linked to either low blood oxygen saturation or cortical arousal. About 25% of individuals in the US have OSA, which is a major cause of excessive drowsiness that lowers quality of life, impairs performance at work, and increases the risk of motor vehicle crashes [1]. Unusually loud snoring is a sign of OSA. The patient alternates between awake and sleep as a result of these episodes, resulting in a cyclical breathing pattern and fragmented sleep.

Respiratory episodes usually last 20–40 seconds and in extreme situations might occur more than 100 times per hour. Major co morbidities linked to OSA include daytime somnolence, reduced cognitive function, low quality of life, and an elevated risk of car accidents. There is sufficient data to conclude that OSA stands alone as a risk factor for a range of unfavorable cardiovascular outcomes. At least 2-4% of adults suffer with the clinical condition, which is defined as more than five abnormal breathing disruptions (hypopneas or apneas) per hour of sleep accompanied with symptoms of daytime sleepiness [2].

In fact, increases in body mass index, accumulation of adipose tissue, and neck circumference are strong indicators of the disease; additionally, the prevalence of OSA is two to three times higher in men than in women, and in older people (>65 years old) as opposed to middle-aged people (30–64 years old)[2]. Obesity is the primary epidemiologic risk factor.

Though most of India's 1.2 billion people live in rural areas, increased connectivity and technological and infrastructural advancements have forced them to embrace an urban lifestyle.

It causes the prevalence of smoking and illnesses like cardiovascular disease which are closely linked to OSA—to rise gradually.

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India has a high prevalence of daytime sleepiness and snoring, which contributes to the misdiagnosis of many OSA sufferers. One significant noncommu-nicable public health risk is undiagnosed OSA.

PATHOPHYISIOLOGY:

The upper respiratory tract in humans is a special, multifunctional system that helps with breathing, food and liquid swallowing, and speech. As a result, the airway is made up of several muscles and soft tissues but has no hard or skeletal support.

Anatomically speaking, a narrower upper airway tends to collapse more frequently than a wider one. The levator and tensor palatine muscles, which advance and elevate the soft palate, as well as the geniohyoid and stylopharyngeus muscles, which oppose medial collapse of the lateral pharyngeal walls, help to prevent posterior collapse of the tongue by contracting with each inspiration. The genioglossus muscle is the most significant upper airway dilator muscle.

Most people with OSA have a constricted upper airway, which is typically caused by fat buildup in the Patients with OSA appear to use protective reflexes, which raise upper airway dilator muscle activity to preserve airway patency, to make up for an anatomically damaged upper airway while they are awake. The relationship between pharyngeal architecture and a decreased capacity of the upper airway dilator muscles to sustain a patent airway during sleep is the pathophysiology of OSA [1,2]. Figure 1 represents Schematic presentation of the typical pathophysiological sequence that occurs in OSA.

RISK FACTORS:

The major risk factors for OSA include advanced age, male gender and obesity.

1) **Age:** It seems that the severity of sleep disorder breathing reduces with age, however the prevalence of the condition among the elderly seems to rise beyond 65 years of age. The lengthening of the soft palate, changes in the body structures surrounding the pharynx, and increased fat deposition in the parapharyngeal area are some of the mechanisms suggested to explain the increased occurrence of sleep apnea in the elderly.
2) **Gender:** The reason why men are more likely than women to have OSA is unknown. It can be related to anatomical and functional features of the upper airway and in the ventilatory response to the

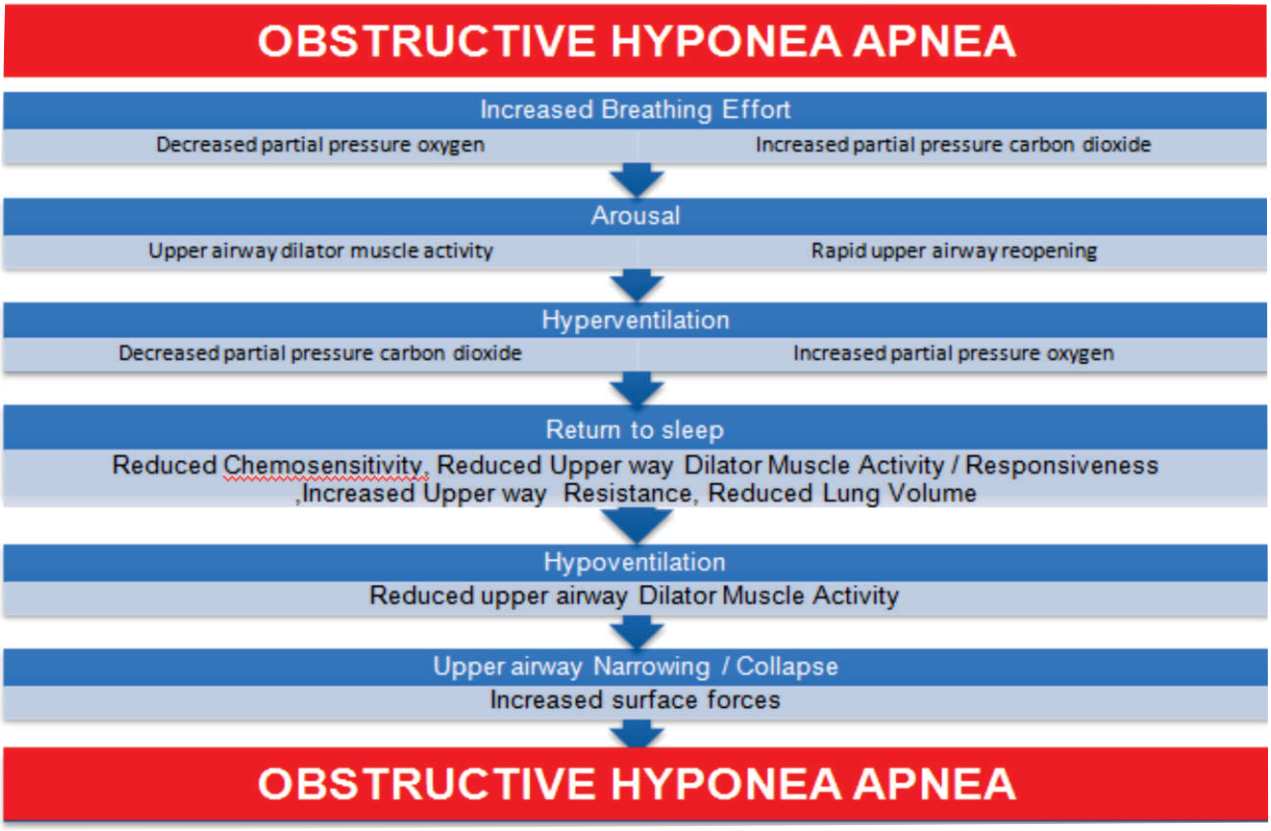
OBSTRUCTIVE HYPONEA APNEA
Increased Breathing Effort
Decreased partial pressure oxygen
Increased partial pressure carbon dioxide
Arousal
Upper airway dilator muscle activity
Rapid upper airway reopening
Hyperventilation
Decreased partial pressure carbon dioxide
Increased partial pressure oxygen
Return to sleep
Reduced Chemosensitivity, Reduced Upper way Dilator Muscle Activity / Responsiveness
,Increased Upper way Resistance, Reduced Lung Volume
Hypoventilation
Reduced upper airway Dilator Muscle Activity
Upper airway Narrowing / Collapse
Increased surface forces
OBSTRUCTIVE HYPONEA APNEA

Figure 1: Schematic representation of the typical pathophysiological sequence that occurs in OSA

arousals from sleep. Compared to women, men have more fat deposited around their pharyngeal airways. There could be a hormonal component to the tendency toward irregular breathing as you sleep.

3) **Obesity:** Obesity is the primary risk factor for developing OSA. It is believed to be linked to anatomical changes that increase body and pharyngeal adiposity, which predisposes to upper airway blockage during sleep.
4) **Genetic predisposition and family history:** It is believed that genetics and familial aggregation factors contribute to the development of OSA. Given that obesity and OSA are closely related and that obesity itself tends to accumulate in families, it is plausible that the genetics of obesity plays a role in the familial aggregation of OSA.
5) **Craniofacial Anatomy:** The upper airway becomes narrower due to the enlarged tongue, soft palate, and inferiorly positioned hyoid bone, which increases the likelihood of the airway collapsing.
6) **Alcohol and tobacco use:** Research has indicated that both alcohol and tobacco use are risk factors for OSA. Snoring and sleep-disordered breathing are more common among people who smoke. Smoking causes inflammation and damage to the airways, which may alter the upper airway's anatomical and functional characteristics and raise the possibility of collapsibility when you sleep. Alcohol raises upper airway.
7) **Nasal Obstruction:** Air naturally enters our bodies through the nasal passages. Any blockage in these channels causes restricted airflow, which is most noticeable when you're sleeping and results in apneas and other OSA symptoms [3,4,].

CLINICAL PRESENTATION:

Loud and persistent snoring is one of the most prevalent night time symptoms of OSA. It is brought on by the upper airway closing considerably during sleep, which restricts airflow and causes turbulence. In the adult population as a whole, snoring is extremely prevalent; 25%–30% of women and 40%–45% of men regularly experience this problem. People who have OSA snore more frequently and intensely with time, and this is frequently related to factors like smoking, weight gain, nasal obstruction, or using muscle relaxants.

Because of the fragmentation of sleep, daytime drowsiness is one of the most prevalent nocturnal symptoms of OSA. Other well-known symptoms of daytime sleepiness include fatigue, difficulty in concentrating, memory loss, mood changes, and decreased libido. Morning headaches and awakening with a sore throat or dry tongue are possible additional symptoms [5].

ASSESSMENT:

Inquiring about snoring, breathing pauses at night, and extreme exhaustion or sleepiness during the day should be part of the systems assessment because of the high prevalence of OSA and the fact that patients frequently do not mention sleep issues to doctors [1].

CLINICAL APPROACH:

Health professionals should not disregard the risk factors of OSA and should detect and diagnose this disorder. OSA screening should be based on sleep-oriented history and physical examination in conjunction with objective tests.

The Berlin Questionnaire, designed for use in the general care context, and the STOP-Bang questionnaire, intended for preoperative screening, are two of the various questionnaires for determining OSA risk. The Epworth Sleepiness Scale is widely used in both clinical practice and research to assess sleepiness, but has low sensitivity for OSA[1].

For any patient experiencing extreme tiredness, excessive drowsiness, or unrefreshing sleep, an OSA test is advised. Patients with morning headaches, nocturnal gastric reflux, unexplained nocturia, or frequent nocturnal awakenings should be evaluated for testing, especially if they also exhibit snoring, observed nocturnal apneas, or an overweight body habit [1].

DIAGNOSTIC TOOLS:

A patient with OSA is diagnosed using a limited number of exact steps. A polysomnography test and a home sleep apnea test are two of these techniques. The most reliable and accurate diagnostic methods are sleep studies, which are the subject of both.

In a hospital, a polysomnography is a test that captures the patient's numerous body movements and functions while they are asleep. The gold standard for diagnosing OSA is this testing procedure. The apnea hypopnea index (AHI), which is derived from polysomnography, is the most significant statistic. By connecting the values of apneas and hypopneas, it illustrates the severity of OSA. It is computed as follows: total sleep time in minutes divided by the

product of all hypopneas and apneas multiplied by sixty. A score of less than five indicates negligible or no OSA. Mild results are those that are 5 or higher but less than 15. A moderate AHI is one that is more than or equal to 15 but less than 30. Lastly, severe OSA is correlated with an outcome of at least 30.

OTHER DIAGNOSTIC TOOLS:

A home apnea test is also a sleep test. Unlike the polysomnography, however, a home apnea test is taken at home and can only test for OSA[5,6,7].

Other diagnostic tools are also available for the diagnosis purpose of OSA such as electoencephalography, electrooculography, electrocardiography, electromyography, pulse oximetry, optical coherence tomography, MRI, CT scan.

DIAGNOSIS: The diagnosis is based on clinical presentation, assessment and diagnostic tools.

MANAGEMENT OF OSA:

The treatment of open-mouth breathing (OSA) involves various measures such as behavioral modification, medication, continuous positive airway pressure, weight loss, oral appliance therapy (using devices to retain tongue or advance the mandible or orthodontic appliance), and surgical procedures (tracheostomy, uvulopalatopharyngoplasty, laser-assisted uvulopalatoplasty, surgically assisted rapid maxillary expansion, maxillomandibular advancement, and stimulation of the hypoglossal nerve).

Behavioral therapies target variables that could increase the risk of OSA. It is advised that all patients with OSA abstain from alcohol and sedatives. Losing weight can improve airway patency for certain patients by reducing snoring and apneic episodes. For certain patients with sleep apnea, avoiding the supine position while they sleep may lessen the frequency of episodes.

NONSURGICAL TREATMENTS:

The most successful strategy to treat OSA is continuous positive airway pressure (CPAP), which is typically used as the initial course of treatment for patients. By functioning as a pneumatic splint to elevate and maintain constant pressure along the upper airway during inspiration and expiration, the mechanism of action enhances the quality of sleepiness [7].

ORAL APPLIANCES (OA):

Patients who do not respond to CPAP or who are not a good fit for it should use OA. Patients who prefer OA over CPAP with mild-to-moderate severity should also use OA. The design elements of commercially available OA vary from one another. Variations mostly concern how much the patient's dentition is customized. Reduction of oxygen desaturation episodes, reduction of AHI, and reduction of symptoms are the metrics used to quantify the effectiveness of OA. In general, two-thirds of patients who get OA therapy report a clinically significant improvement in their symptoms [8].

MEDICATIONS:

Even with consistent use of CPAP at effective pressures, medication can be utilized as an adjuvant to reduce residual daytime drowsiness in patients with OSA. One such drug that aids in wakefulness and alertness is modafinil (Provigil; Cephalon, Frazer, PA). Headache and jitters are the most frequent side effects of this drug [8].

MECHANISM OF ACTION OF MODAFINIL:

Modafinil is a central nervous system (CNS) stimulant that does not include amphetamines and has the ability to increase wakefulness. It is well known that modafinil has little to no in vivo affinity for the norepinephrine (NE) or serotonin (5HT) transporters and is a poor inhibitor of dopamine reuptake. On the other hand, once modafinil was administered, there were higher levels of NE and 5HT in the prefrontal cortex and hypothalamus, which could be an indirect result of increased extracellular dopamine.

Modafinil cannot be injected intravenously because it is insoluble in aqueous solutions and easily absorbed when taken orally [9].

SURGICAL INTERVENTION:

The extremely low documented propensity of modafinil to produce the euphoric effects of conventional psychostimulants (such as cocaine and amphetamine) is one of its possible advantages. Since modafinil is soluble in water and easily absorbed when taken orally, it cannot be injected intravenously Modafinil is a central nervous system (CNS) stimulant that does not include amphetamines and has the ability to increase wakefulness.

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Patients with severe OSA should use it. Maxillomandibular advancement, in which the maxilla and mandible are simultaneously advanced to widen the retropalatal and retrolingual airway, is one of the most successful surgical procedures for addressing OSA. Uvulo-palatopharyngoplasty (UPPP), which entails the removal of the tonsils, uvula, and posterior velum, is an additional option. The lingual tonsil surgery and hyoid suspension myotomy procedure are two surgical techniques that can be used to prevent the posterior collapse of the tongue musculature; in this case, the tongue size will be altered by intrinsic reduction, radiofrequency or plasma frequency ablation, or partial glossectomy[9].

CONCLUSION:

Sleep disordered breathing is an extraordinarily common condition. Pharyngeal during sleep as a consequence of abnormal structural anatomy and loss of muscle tone during sleep is the defining event. Defined obstructive sleep apnea occurs in 2% to 4% of middle aged adults. Sleep apnea is associated with a wide variety of health concerns including a lower quality of life, neurocognitive disfunction, medical/ cardiovascular morbidity especially related to cardiovascular outcomes, and increased mortality risks. A wide variety of therapies have been described to treat sleep disordered breathing. These range from modifying predisposing conditions, reducing medical risk factors (such as obesity), appliances (oral, nasal, and CPAP), and finally upper airway surgeries. Nasal CPAP is the most common medical treatment and has revolutionized treatment since its introduction by Sullivan in 1981. It is of complete importance to raise awareness of this disorder among community members and increase its recognition in health sectors to help in the early diagnosis and intervention for OSA.

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Conflicts of Interest

There are no conflicts of interest.

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Review Article

Infant Oral Health: A Literature Review

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ABSTRACT:

The American Academy of Pediatric Dentistry and the American Academy of Pediatrics advise that children undergo dental examinations and assessments within their first year of life. Early dental visits evaluate a child's risk status through parental interviews and oral examinations. Infant oral health plays a crucial role in a child's overall development. This article offers a concise overview of different aspects of oral health care for children, highlighting perinatal oral health care, anticipatory guidance, the concept of a dental home, the first dental visit, oral health examinations, dietary counseling, and therapeutic interventions for relevant oral issues, including teething. It serves as the foundation for lifelong preventive education and dental care, aimed at achieving optimal oral health throughout childhood.

KEYWORDS: Infant oral health, Infant, Oral health examination

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INTRODUCTION:

Child development from conception to the age of one year is the most dynamic phase in terms of growth and development. Based on different age groups, humans are categorized into various stages and terms: from birth to 1 month is a neonate, 1 month to 1 year is an infant, 1 to 3 years is a toddler, and 3 to 6 years is a pre-schooler. The American Academy of Pediatric Dentistry (AAPD) emphasizes the significance of oral health in infants, viewing it as the foundation for building preventive education and dental care, to maximize the chances of a lifetime free from preventable oral diseases.[1] Traditionally, dental care in children has mainly aimed at preventing the development and progression of caries, premature loss of primary teeth, loss of dental arch length, and the formation of anxiety associated with dental visits. The role of a pediatric dentist is to guide both the child and the parent, addressing oral issues before they impact overall health and dental alignment.[2] To achieve and sustain these goals, it is crucial for the dentist to conduct the initial oral examination during infancy, in consultation with the child's parent. In this regard, pediatric dentists hold a special responsibility toward children, their parents, and society as a whole. Hence, the preventive process should begin early in infancy to ensure a successful outcome.

GOALS OF INFANT ORAL HEALTH CARE:

1. To identify, intercept, and adjust potentially harmful parenting practices that could negatively impact an infant's oral health.
2. Parent education right from the prenatal period
3. Parent/caregiver orientation to perceive dental services as an integral part of infant's overall health program
4. Periodic evaluation of the oro-facial development and oral health by the clinician
5. To break the cycle of early childhood caries
6. To manage the risk/benefits of oral habits

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7. Impart optimal fluoride protection
8. Use anticipatory guidance to arm parents in therapeutic alliance

Perinatal oral health care, dental home concept, first dental visit, oral health examination, food counselling, and therapeutic interventions for pertinent oral findings such teething are all included in infant oral health care.[1]

PERINATAL ORAL HEALTH CARE:

Both the mother's and the child's oral health are impacted by the mother's overall health. Preventing dental diseases may start with educating expectant mothers about their oral health, the effects of untreated dental conditions such gingivitis and caries, and how these conditions will affect their unborn children. The 'perinatal period' is the time starting from the delivery, till the end of the 20th to 28th week of pregnancy and continuing for one to four weeks after delivery.[3] As a result, the perinatal period is crucial to both the newborn's and the pregnant woman's general health. In terms of caries transmission, the main objective of perinatal oral health care is to reduce the amount of cariogenic bacteria in the mouth of the expectant mother in order to postpone the infant's colonisation by Streptococci Mutans (SM) for as long as possible. Premature birth, low birth weight, and pre-eclampsia are among the negative outcomes associated with periodontal disease during pregnancy, according to studies.[4] Pregnancy presents an opportune moment to prioritize health-enhancing activities, as many women engage consistently with healthcare providers. These professionals can identify risk factors prior to the onset of disease and assist in the creation of a dental home.[5]

ANTICIPATORY GUIDANCE:

Anticipatory guidance refers to the proactive engagement with parents and patients regarding anticipated developmental changes that occur between medical appointments, encompassing essential information on daily care.[6] This proactive counselling involves delivering practical and developmentally appropriate insights into children's health, equipping parents to navigate significant physical, emotional, and psychological milestones.[7] It establishes a preventive framework that extends beyond the prevention of dental caries, addressing comprehensive aspects of children's oral health, including oral hygiene practices, dietary advice, and the recommended frequency of routine dental check-ups. Research indicates that, irrespective of race or health status, anticipatory guidance and pediatric visits during the first two years of life can significantly lower hospitalization rates among children.[8] Consequently, implementing oral health anticipatory guidance can lead to a reduction in dental care costs.

DENTAL HOME CONCEPT:

A dental home refers to a sustained partnership between a dentist and a patient, encompassing all facets of oral health care provided in a comprehensive, readily available, coordinated, and family-oriented manner. It is advisable to establish a dental home by the time a child reaches 12 months of age, with referrals to dental specialists made as needed.[9] Children who have a designated dental office are more likely to receive timely preventive and routine oral care. It is recommended that referrals from primary care physicians or other healthcare providers occur based on risk assessments as early as six months of age, six months after the first tooth emerges, and no later than 12 months of age.

FIRST DENTAL VISIT:

The initial dental appointment represents a significant milestone in a child's development, and regular visits should be a fundamental aspect of their overall healthcare regimen. AAPD advises that infants, along with their parents, should have their first oral examination scheduled within six months following the emergence of their first primary tooth, but no later than their first birthday. The primary objective of this inaugural dental visit is to establish a foundation for preventive education and dental care, ensuring optimal oral health during infancy.[10] During this visit, the dentist should be equipped to detect any early lesions, evaluate the growth of craniofacial and dental structures, and provide guidance to parents regarding appropriate oral hygiene practices, nutrition, and responses to potential trauma.[11]

ORAL HEALTH EXAMINATION:

The knee-to-knee position is typically advised for children aged 6 months to 3 years. It is essential for examiners and parents or caregivers to collaborate to facilitate a seamless transition from the interview phase to the evaluation process. Clinicians should provide a clear explanation of the procedure beforehand, following the 'tell, show, do' approach, and should be prepared for the possibility that infants may cry.[12] Positive experiences during visits are often linked to the child witnessing friendly and supportive interactions between the doctor and caregiver. This

positioning allows the child to maintain visual contact with the parent throughout the examination. Additionally, caregivers can observe clinical findings and hygiene practices directly while gently assisting in stabilizing the child for a safe clinical assessment.

DIET COUNSELLING:

Dietary choices significantly influence both overall health and oral health. Research indicates that nutrition plays a crucial role in dental development, and malnutrition can worsen periodontal and oral infections. Consequently, it is advisable to establish healthy eating habits by 12 months of age and to sustain them throughout early childhood. The first dental visit should involve a comprehensive assessment of the child's dietary habits, including the types of foods consumed, their frequency and quantity, sugar intake, and snacking patterns. [13] Breastfeeding is considered the optimal nutrition for infants, as it provides a well-balanced array of nutrients tailored to their evolving needs.[14] AAPD advocates for breastfeeding as the preferred method of feeding, recommending exclusive breastfeeding for the first six months, followed by the introduction of iron-fortified solid foods between six to twelve months.[15]

Research indicates that infants who receive a higher proportion of breast milk compared to infant formula, or who are breast-fed for extended durations, tend to have a reduced likelihood of becoming overweight in later childhood and adolescence. Nevertheless, AAPD advises that unrestricted nocturnal breast-feeding should be discontinued once the first primary tooth has emerged. [16] Additional studies have shown that the pasteurization process involved in formula production can alter the structure of cow's milk proteins, potentially diminishing any protective effects against infections across species. Infant formulas are known to be acidogenic and have cariogenic properties. Therefore, it is crucial to evaluate the feeding practices and dietary habits of toddlers to determine their risk for early childhood caries (ECC). The Feeding At Sleep Time (FeAST) scale is a novel, parent-reported tool designed to assess various aspects of parental feeding behaviors related to the sleep-time of infants and toddlers.[17] This scale helps differentiate sleep-time feeding practices from other dietary habits, allowing for a better estimation of ECC risk and serving as a resource for further research into the impact of sleep-time feeding on ECC development.

WEANING:

'Weaning' refers to the process of introducing semi-solid foods to infants, typically around the age of six months. This stage often includes the addition of soft, cooked vegetables such as carrots, as well as diced soft fruits like pears and bananas.[18] AAPD recommends that any food provided to infants should be either mashed or cut into small, manageable pieces for easy chewing. It is important that this process occurs under appropriate supervision.

Weaning tips for mothers:

1. Gradually enhance the quantity of food provided to an infant, ensuring that it aligns with their increasing appetite.
2. Offer food based on the infant's capacity to chew and digest effectively.
3. Create nutritious combinations using high-quality ingredients, which safeguard infants from illness and support healthy weight gain relative to their age.
4. Ensure that all food items and the utensils used for preparation are thoroughly cleaned.
5. Increase food intake during and following periods of illness, and provide additional fluids, particularly if the infant is experiencing diarrhea.

TEETHING:

Teething is a natural physiological process that usually occurs with little or no difficulty and often with minimal complications. It involves the sequential emergence of an infant's teeth as they penetrate through the gums.[19] Teething is historically referred to as 'dentition difficilis,' a Latin term meaning difficult or pathological dentition. This process entails the movement of teeth from their position within the jawbone to their emergence in the oral cavity. The teething phase is generally characterized by an 8-day period, which encompasses 4 days prior to the tooth breaking through and 3 days afterward.[20] The eruption of primary teeth typically commences between 4 to 8 months of age, starting with the lower incisors, and is generally completed by 24 to 30 months when the second primary molars emerge. Common signs and symptoms associated with teething include irritability, increased drooling, mild fever, diarrhea, and disrupted sleep patterns. (Table No 1)[21]

Teething management encompasses both pharmacological and non-pharmacological approaches. Non-pharmacological strategies involve the use of solid silicone teething rings, as well as a selection of fresh and frozen fruits and vegetables that infants can 'gnaw' on for temporary relief. Additionally, gently massaging the baby's gums with a clean finger or wet gauze for one to two minutes can help alleviate

Table 1: Signs and symptoms of teething.

Signs/symptoms	Features
Irritability	Tooth rises closer to the surface; gums may become increasingly sore and painful.
Drooling	Drooling of saliva is increased than normal from 34 months of age
Coughing	The extra saliva can occasionally cause cough or gag.
Chin rash	Excessive drooling can irritate the skin around the chin and mouth leading to rashes.
Biting and gnawing	The counter pressure from biting or gnawing on an object helps to relieve the pressure from under the gums.
Diarrhoea	Most parents usually notice slightly looser bowel movements when a baby is teething. Most likely the cause is extra saliva swallowed.
Low grade fever	A low-grade fever can be defined as a temperature above 36.5 degrees and fluctuating constantly but not exceeding 38.5 degrees.
Disturbed sleep	Teething may cause pain more often at night. When the pain becomes too much child's sleep gets compromised.

discomfort. When local measures do not suffice, pharmacological options are available, including a variety of effective topical and systemic treatments, such as topical choline salicylate products and sugar-free paracetamol elixir, which is often the preferred systemic medication.[19]

FLUORIDE:

Optimal fluoride exposure is crucial for all infants and children with teeth. The decision to administer fluoride should be tailored to the individual needs of each patient. Research supports the safe and effective use of fluoride in preventing and treating dental caries. After assessing all potential dietary sources of fluoride, it is advisable to consider systemic fluoride administration for children at risk of caries who consume water with fluoride levels below 0.6 ppm. [22] Community water fluoridation continues to be the most cost-effective strategy for caries prevention.[23] A significant portion of an infant's diet consists of human milk or milk from other mammals; however, the fluoride concentration in breast milk is low because only a small amount of fluoride transfers from plasma to breast milk. In contrast, infant formulas can contain varying levels of fluoride, primarily influenced by the fluoride content of the water used to prepare them. [24,25]

CONCLUSION:

Infant oral healthcare begins ideally with prenatal oral health counselling for parents, which emphasizes on the benefits of a non-cariogenic diet and nutritious foods that are essential for proper fetal development. An array of factors contributes to the oral health of a child. Finding a dental home and having a preventive care plan can decrease the likelihood of the infant to experience dental disease. Educating the parents and/or caregivers on preventive practices, good oral hygiene, transmission of cariogenic bacteria, injury prevention and the importance of having regular scheduled visits at appropriate intervals, plays an important role in maintaining the good oral health for child. An initial oral examination visit should occur within 6 months of the eruption of the first primary tooth but by no later than 12 months of age. Feeding practice and dietary counselling should be evaluated. Also, parents should be educated about teething which occurs between four to six months of age during which gums become red and swollen. With the combination of proper diet, early oral hygiene, and exposure to systemic fluorides, we can promote a generation of caries-free children, providing that the dental care program be initiated at or before the eruption of the first primary teeth.

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Conflicts of Interest

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Review Article

3 D Printing : Its Applications in Pediatric Dentistry Practice

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ABSTRACT:

Digital dentistry is a concept getting more and more contour nowadays, due to the latest technological advancements registered in the field. This paper makes a review of one of the newest digital technology, 3D Printing which is in its nascent stage to prove usefulness in Pediatric Dentistry. This technology would help in diagnosis, or would simplify procedures for both pediatric dentist and patient, and thus would contribute significantly in increasing the quality of the therapeutic act.

KEYWORDS: digital dentistry, 3D printing, pediatric dentistry

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INTRODUCTION:

Technology advancements have ushered in a new age in medicine. Digital dentistry is no longer just a concept; it is now a fully operational reality, allowing patients to obtain innovative answers to conventional tooth issues. The development of novel modalities, such as 3D printing, has expanded the field of practise. Three-dimensional (3D) printing technologies, also known as additive manufacturing, are advanced manufacturing methods that use CAD digital models to autonomously create personalised 3D things. They've also been widely used in the disciplines of industry, design, engineering, and manufacturing for about 30 years 3D printing is commonly used for digital imaging in surgical planning, communication, and craniomaxillofacial surgery in the field of drugs, such as traumatology, cardiology, neurosurgery, cosmetic surgery, and craniomaxillofacial surgery.[1]

Three-dimensional printing has many applications in dentistry starting from prosthodontics, oral and maxillofacial surgery, and oral implantology to orthodontics, endodontics, and periodontology. These technological advances in dentistry have increased accuracy, eased delivery and decreased chair time, thus allowing dental teams to supply simpler treatment. The incorporation of digital impressions and computer aided designs (CAD/CAM) are certain examples of how technology has led to the paradigm shift in the approach to treatment which allows precise fabrication of aligners, removable prosthetics and templates for implants. In lab fabrication is done by creating a 3D final product via an additive process. 3D printing and CAD/CAM technologies alsoallow fabrication of removable prosthesis and surgical templates for implants. Three-dimensional technology has multifold applications, and thus the rapidinnovations within the medical field have been represented by the advent of the 3D printing itself[2]. For fabrication of printed model five significant steps are required (Figure-1).The steps include,selection of the anatomical target, the event of the 3D geometry through the processing of the medical images coming from a CT/MRI (Computed tomography/magnetic resonance imaging)can, the

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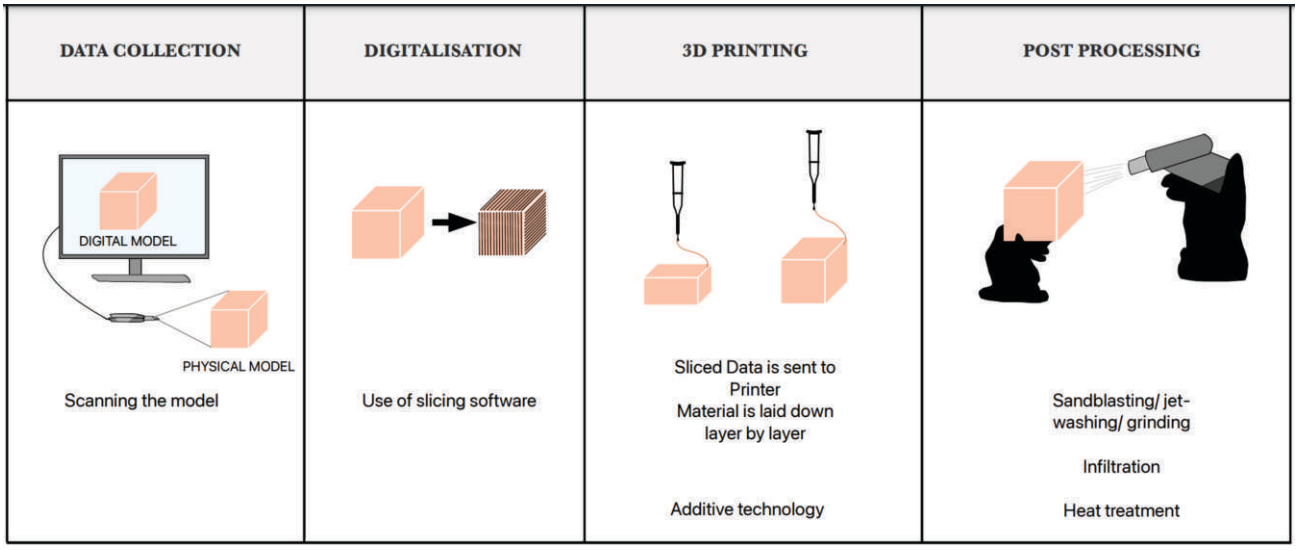

Figure 1: Process & mechanism of 3D Printing.

optimization of the file for the physical printing, and therefore the appropriate selection of the 3D printer and materials. This file represents the guidance for the next printing, "slicing" that digital design model into cross sections. 'at "sliced" design is then sent to a 3D printer, which manufactures the thing by starting at the bottom layer and building a series of layers on top until the object is made using the raw materials that are needed for its composition. At the termination of the process a patient-specific model with anatomical fidelity created from imaging dataset is finally obtained.

HISTORY OF 3-D PRINTING:

The early 1980s saw first unit for 3D printing beinglaunched in the market. Charles W. Hull (founder of 3D Systems), S. Scott Crump (founder of Stratasys), and Hans J. Langer and Hans Steinbichler were the pioneers of this innovative technology. In 1986, first 3D printer was patented by Charles W. Hull.[3] Until then, 3D printers were mainly used for rapid prototyping. Following the expiration of the patent for the fused deposition modelling (FDM) process in 2009, the 3D printers began to make enormous inroads into the consumer sector.[4] This was ultimately carried over to the dentistry. Thereafter, printing units became more smaller and cheaper, and thus their fields of application changed. The technology advanced rapidly in the ensuing years and the printable materials expanded to include plastics, metal, ceramics, and even human tissue. Rapid-prototyping processes can be categorized by the type of materials used (plastics, metals, or powder).[5]

3D Printing technology is not entirely new. It has been introduced in dentistry 20 years back. Laser Sintering (selective laser melting) presented in November in 2002 for printing metals caused a sensationand it received worldwide acceptance as the basis of manufacturing metallic structures (such as crowns & bridges, or clasp-retained cast-metal frameworks).[5]

TYPES OF 3D PRINTING:

3D printing technology build parts layer-by-layer and each varies within the way they form plastic and metal parts and may differ in material selection, surface finish, durability, and manufacturing speed and price.

There are several sorts of 3D printing, which include:

1. Stereolithography.
2. Selective Laser Sintering.
3. Fused deposition modeling.
4. Digital Light process.
5. Multi jet fusion.
6. Poly jet.
7. Direct metal laser sintering.
8. Electron beam melting.

Except, multi jet fusion & electron beam melting all of them have dental application (Figure-2).

APPLICATIONS OF 3D PRINTING:

Since 1980s, 3D printing technologies have found application in development, data visualization, rapid prototyping, and specialized manufacturing including production (job production, production, and distributed manufacturing). There are many

Types of Printing Techniques	Advantages	Disadvantages
SLA	• Highest resolution and accuracy • Can be used for variable materials • Records fine details with functional prototypes v	• Costly • Complex processing • Hazardous materials used • Product formed is weak
SLS	• Low cost • Uses wider range of materials	• Polymer must be in powder • Maintenance high • Cannot be used for large parts
DLP	• Components are simple • Smooth finish achieved	• Lower resolution in large parts • Cannot be used in areas of high accuracy
FDM	• Low cost • No risk explosion • Suitable for complex structures	• Low resolution and accuracy • Parts need smoothening process after print

Figure 2: Types of 3D printing in dentistry and their advantages & disadvantages.

applications for Additive Manufacturing technologies AM, including Architecture, Engineering and Construction (AEC), industrial design, automotive, aerospace, military, engineering, dental and medical industries, biotech (human tissue replacement), fashion, footwear, jewellery, eyewear, education, geographic information systems, food, and lots of other fields.

1. Mass customisation:

Certain Companiescustomize objects using simplified web-based customization software and order the resulting items as 3D printed unique objects. The 3D designs launched by NOKIA for its case provides customers with the preference to customize their own case and have it 3D printed are few examples of it.[6]

2. Rapid Manufacturing:

Unique advantage of 3D printing lies in the inexpensive production of small numbers of parts.

3. Rapid prototyping:

There are generally larger machines that use proprietary powdered metals, casting media (such as sand), paper, plastics, or cartridges, and are used for rapid prototyping by universities and commercial companies.

4. Research:

3D printing has been utilized in research labs as alternative method to manufacture components to be used in experiments, like magnetic shielding and vacuum components with demonstrated performance comparable to traditionally produced partsand to form specialized, bespoke geometries.[7]

5. Food:

A large variety of foods are appropriate candidates, such as chocolate and candy, and flat foods such as crackers, pasta, and pizza. A food-tech start-up Novameat from Barcelona 3D-printed a steak from peas, rice, seaweed, and some other ingredients that were laid down criss-cross, imitating the intracellular proteins.[8]

6. Industrial:

3D printing has entered the planet of clothing with fashion designers experimenting with 3D-printed bikinis, shoes, and dresses. For example, in commercial production, Nike used 3D printing to prototype and manufacture the 2012 Vapor Laser Talon football shoe for players of yank football, and New Balance is 3D manufacturing custom-fit shoes for athletes.

7. Bio-printing:

3D bio-printing technology has been studied by biotechnology firms and academia for possible use in tissue engineering applications during which organs and body parts are built using inkjet techniques. The first production system for 3D tissue printing was delivered in 2009, supported NovoGen bioprinting technology.

8. Medical devices:

3D printed prothesis and implants are being fabricated not only for human beings but also for animals. For example, hand prosthesis, hearing aid, knee implant etc.

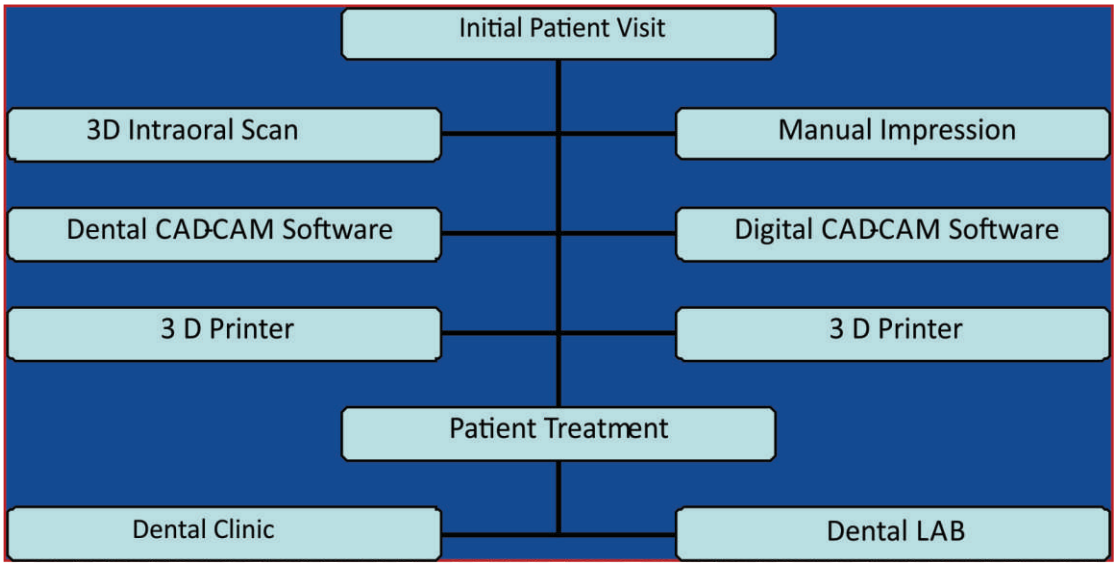

Figure 3: Digital workflow using 3D printing for diagnosis & dental treatment.

9. Pharmaceutical Formulations:

In August 2015 the FDA approved the primary 3D printed tablet. Binder-jetting into a powder bed of the drug allows very porous tablets to be produced, which enables high drug doses during a single formulation that rapidly dissolves and is definitely absorbed. Nowadays, other printing techniques such as Selective Laser Sintering (SLS) and Stereolithography (SLA) are also gaining traction and are being used for pharmaceutical applications.[9]

DENTAL APPLICATIONS OF 3D PRINTING:

Comfort, function, speech, and aesthetics is the ultimate goal of providing dental treatment to the patient following accurate diagnosis.[10,11,12] 3D printing technology has gained acceptance and is used for a good range of applications in almost every field of dentistry (Figure-3).

1.Prosthodontics:

Custom trays can be manufactured, or 3D printed from computerised scans of impressions or models.[13] In fixed and removable prosthodontics, restorations could be designed using CAD software and crowns, bridges, copings, abutments, etc can be printed using 3D printers (Figure-4).[14]

2. Dental Implantology:

3D printing helps within the easy production of complex geometry dental implants and surgery guides or drill guides (Figure-5).[15] 3D printers also print bone tissue favouring the requirements of the patient that can act as a biomimetic scaffold in the mouth for bone cell

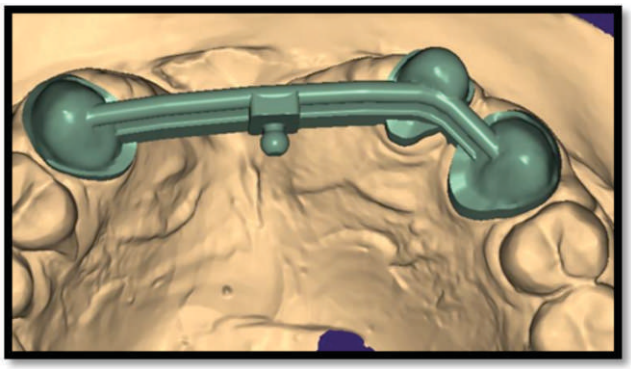

Figure 4: 3D printed temporary crown & resin pattern for casting.

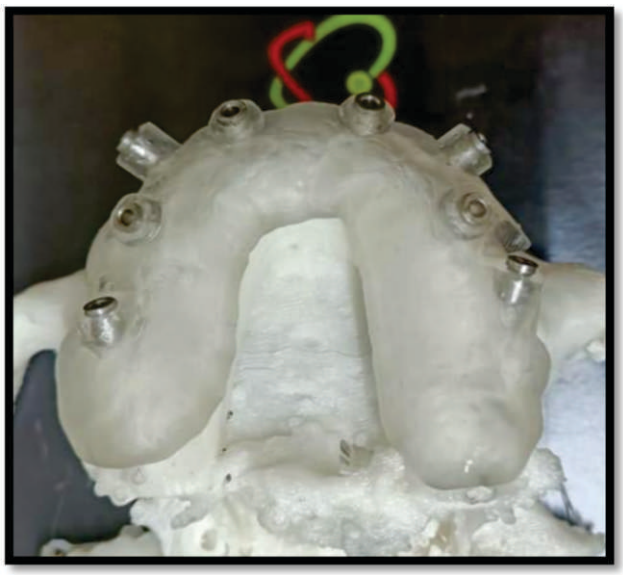

Figure 5: 3D printed surgical guide for implant placement.

enhancement, tissue growth and differentiation.[16]

Prefabricated dental implant surgical guides can be used for verifying or guiding the proper location, angulation and rotational positioning of the implant prior to the placement in order to provide better aesthetics and functionally stable prosthesis.[17]

3. Oral & Maxillofacial and Orthognathic surgeries:

3D models of detailed replicas of the skull and jaws of patients serve as anatomical models which have been beneficial in pre-surgical planning and also serve as a reference during surgery.[18] Surgical guides, augmentation of bone defects and creating replicas of jaws that could serve as study models for students, fixation plates etc can be 3D printed and used for Oral and Maxillofacial and Orthognathic surgeries.[19]

4. Endodontics:

3D printing serves as a solution to endodontic challenges, such as guided access preparations, auto-transplantation, pre surgical planning, education models and stent guides.[20]

5. Orthodontics:

Indirect bracket-bonding splints, occlusal splints, aligners, etc can be 3D printed.[21]Adjustment or customization in terms of angulation, bending, etc is possible during the manufacture of brackets. In addition to this, it is now virtually possible to present the changes that will be caused by the braces in advance.[22]

6. Periodontics:

In 3D periodontology, 3D printing is employed for regenerative periodontal research. Few of the main periodontal post-operative complications include mobility, loss of attachment, furcation, painful and bleeding gums, gingivitis cellulitis and MRSA mediated skin and soft tissue infections. 3D printed guides are used for aesthetic gingival correction.[23]

3D PRINTING IN PEDIATRIC & PREVENTIVE DENTISTRY:

As far as children are concerned, 3D printing proves to be an easier, patient friendly tool in order to gain patient cooperation in the dental office. Though, 3D printing is not much extensively used for the pediatric dental patients, but there is evidence found in the literature that proves efficiency and effectivity of 3D printing in pediatric dentistry.

1. Aesthetic restorations:

3D printed templates provide efficient, convenient and esthetic option for the direct resin composite restoration of fractured anterior teeth. They help to reproduce the anatomy, colour and translucency of the fractured tooth with precision.[24]

2. Designing & fabrication of space maintainers:

Following impression making and dye preparation, the trial design is obtained by scanning the cast using the digital dental scanner, and the digital design of the band & loop space maintainer similar to the conventional space maintainer is obtained. 2 types of materials can be used for 3D printing of space maintainers that is titanium based powdered metal material (Figure-6) and clear photopolymer resin.[25]

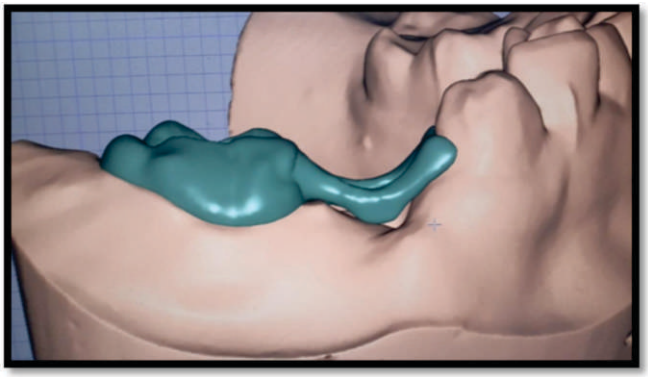

Figure 6: Digital design of Band & Loop space maintainer.

Compared with plaster models, the working models prepared using 3D printing technologies have many advantages, including the lighter weight, lower damage probability to most of the materials, better durability, higher wear resistance, and the share of digital data.[26]

3. Impression making:

Small children and those with special needs may experience gag reflex during placement of loaded impression trays in the mouth. Scanning & 3D printing treatment not only reduces the chair side time, but it is also comfortable for both the patient and the operator.

4. **Splint designing during dental traumatology:**

In dental traumatology, 3D printing has already found its use in prosthodontic rehabilitation and implant designing for management of avulsed teeth. Contemporary splints even after best modifications cannot guarantee accurate repositioning and durability. According to Tiwari et al, digitally scanned information through cone beam CT will enable designing of such a

splint which can then be cemented or cured into its position in traumatised region.[27]

5. 3D scaffold printing in regenerative dentistry:
Use of 3D printing has already been utilised for designing and creating customised scaffolds, where stem cells can be retained and regenerated in presence of growth factors.[28]

6. Auto transplantation:
3D printed templates help to achieve a guided atraumatic approach in auto transplantation of tooth. Strbac et al stated that this can lead to fewer failure rates and improved outcome. An innovative method for auto transplantation of teeth using 3-dimensional (3D) surgical templates for guided osteotomy preparation and donor tooth placement has been described in literature.[29]Vandekar et al used 3D printing to scan and replicate an impacted permanent maxillary central incisor. This rapid prototype tooth replica was then used as a guide for checking socket dimensions during surgical preparation of recipient site. This enabled accurate positioning and preserved viability of periodontal ligament.[30]

7. Reconstruction of comminuted fractures of mandible:
Contouring of bone plates after reduction of complex mandibular fractures is an elaborate and time-consuming process. 3-D-printed templates assist in preoperative planning for treating complex mandibular fracture and also facilitate contouring of plates.[31]

8. 3D printing in sports dentistry:
Another major avenue for employing 3D printing technology is trauma prevention in sports dentistry. This novel technique can help in manufacturing the customised mouth guards in single appointments and keep the information stored for re-orders even at a click of a smart phone-based application.[27]

9. Education models for students:
3D printing is the ultimate tool for educational and training of students in oral surgery, endodontic and prosthodontics. For pre-clinical training in pediatric endodontics, there is a dearth of appropriate primary teeth models which mimic the actual anatomy of the primary teeth. 3D printed tooth models base on computerized tomographic images of extracted teeth are more realistic anatomical passage structure compared to plastic typodont teeth. Marty et al compared the perception of students between 3D printed models versus series models in hands-on pediatric dentistry sessions and concluded that 3D printed models were perceived more idealistic to the students as they offered more realistic experience.[32,33]

LIMITATIONS OF 3D PRINTING:

Ceramicis a widely used dental material, it lack the ability to be 3D printed due to high porosity caused during fabrication.[34,35]

Certain disadvantages associated with this advanced technology includes high cost, availability, materials, maintenance, and the need for skilled operators must also be carefully considered, as well as the need for post-processing and adherence to strict health and safety protocols. Skin irritation, mess, inflammation due to contact and inhalation of powders, the requirement of support materials are added limitations to the use of this technology.

CONCLUSION:

3D imaging and modelling, and CAD technologies are hugely impacting on all aspects of dentistry.

This futuristic technology is a boon to pediatric dentistry as it offers efficiency, accessibility, speed, accuracy and eliminate dental labs manual modelling; this in all improves quality of dental care to the pediatric patients with good level of cooperation.

The advantages of 3D printing technology outweigh the disadvantages. Research and employment of improved techniques in the upcoming years, the disadvantages of 3D printing could be corrected.

Overall, 3D printing technology has a tremendous potential to transform education, research, and treatment care in dentistry.

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Conflicts of Interest
There are no conflicts of interest.

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Review Article

Beyond Toothpaste: The Role of Intraoral Fluoride Devices in Oral Health Maintenance

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ABSTRACT:

Dental caries remains a significant concern, particularly among medically compromised individuals, those with mental disabilities, and the elderly. Fluoride has long been utilized as a preventive measure against dental caries through various modalities, including water fluoridation, systemic intake, and topical applications. Intraoral fluoride-releasing devices represent an innovative advancement in preventive dentistry, offering a targeted and sustained approach to reducing caries incidence. These devices provide controlled, long-term fluoride release directly into the oral cavity, ensuring optimal fluoride levels in saliva and dental plaque. This mechanism supports enamel remineralization, inhibits demineralization, and suppresses the activity of cariogenic bacteria. Diverse designs, such as fluoride-releasing elastomers, polymer-based systems, and bioadhesive materials, have demonstrated effectiveness in both clinical and experimental settings. This review examines the types and clinical applications of intraoral fluoride-releasing devices, emphasizing their role in caries prevention and potential directions for future research.

KEYWORDS: Dental caries, Fluoride, Intra oral fluoride-releasing devices.

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INTRODUCTION:

Dental caries occur when bacteria in dental plaque produce acids that progressively erode the enamel. Preventive measures include enhancing oral hygiene routines and utilizing a combination of chemical agents and physical methods to minimize dental plaque[1]. Fluoride is a powerful active ingredient that effectively prevents dental caries and aids in reversing and remineralizing early enamel lesions. It can be administered in several ways, such as through fluoridated drinking water, fluoride tablets or liquids, fluoride-containing mouth rinses, toothpaste, or food, as well as by applying fluoride solutions, gels, or varnishes directly to the teeth[2].

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HISTORY OF FLUORIDE DEVICE USE IN DENTAL CARE:

The role of fluoride in dental care has been fundamental in reducing the incidence of tooth decay (caries). From the initial observations of its natural presence in water to the development of advanced fluoride delivery systems, fluoride has shaped the trajectory of modern dentistry. Over the years, various

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fluoride devices have been developed to aid in the topical application of fluoride to the teeth, enhancing remineralization and preventing caries. The evolution of fluoride device use reflects ongoing innovations in dental technology and preventive care.

Early Discoveries and the Rise of Fluoride Use:

Fluoride's beneficial effects in dental care were first noted in the early 20th century. In the 1930s and 1940s, researchers observed that individuals living in areas with naturally fluoridated water had lower rates of dental caries compared to those in areas with low fluoride levels. One of the pioneering studies by H. Trendley Dean (1942) demonstrated that fluoride in drinking water led to fewer cavities and improved dental health across populations, provided the fluoride concentration remained within a certain range. This groundbreaking work spurred the development of water fluoridation programs, which began in 1945 in Grand Rapids, Michigan, and later expanded globally[3].

However, while water fluoridation was a public health success, researchers also sought ways to target fluoride treatment to individuals who may not have access to fluoridated water, as well as to those at higher risk for cavities.

Fluoride Toothpaste and Topical Applications (1950s–1960s):

The introduction of fluoride toothpaste in the 1950s marked a major milestone in the widespread use of fluoride for dental care. In 1955, Procter & Gamble launched the first commercially available fluoride toothpaste under the brand Crest, which was later approved by the American Dental Association (ADA) in 1960. The active ingredient, sodium fluoride, was found to reduce dental caries by strengthening tooth enamel. Studies by Keyes et al. (1959) and Marquis et al. (1972) confirmed that fluoride toothpaste could significantly lower caries incidence in the population, making it one of the most effective preventive dental products available.

In addition to toothpaste, topical fluoride treatments like fluoride gels and mouth rinses also gained popularity in the 1960s. These concentrated treatments were designed for use by dental professionals, particularly for patients at high risk for caries, such as children and individuals with weakened enamel. These topical agents helped remineralize enamel and reduce the progression of early carious lesions[4,5].

The Advent of Intraoral Fluoride Devices (1970s-1980s):

As dental professionals sought more targeted and sustained fluoride delivery methods the 1970s saw the introduction of intraoral fluoride devices, aimed at providing prolonged fluoride exposure to individuals with specific needs.

a) The Copolymer Membrane Fluoride Device (1970s):

One of the early innovations in controlled fluoride release came in 1976 with the development of the copolymer membrane fluoride device by Cowsar et al.

This device utilized a fluoride-loaded copolymer matrix encapsulated within a thin, permeable membrane, designed to release fluoride ions gradually into the oral cavity. The primary advantage of this system was that it allowed for continuous fluoride delivery over an extended period, promoting remineralization of tooth enamel and helping to prevent caries. Cowsar and colleagues (1976) created a membrane-controlled reservoir system for fluoride release. The system consisted of an acrylic polymer matrix filled with granulated sodium fluoride (NaF), enclosed within a copolymer membrane. The core matrix was made from a 50/50 mixture of hydroxyethyl methacrylate (HEMA) and methyl methacrylate (MMA), while the surrounding membrane was made from a 30/70 HEMA/MMA copolymer. This membrane controlled the rate of fluoride release, ensuring a slow, sustained delivery. Each fluoride pellet within the device contained 35 mg of sodium fluoride and was designed to release an average of 0.12 mg of fluoride per day over a period of approximately 130 days. The rate of fluoride release was regulated by two factors: the degree of hydration of the matrix and the membrane's thickness, which acted to modulate the flow of fluoride ions. As the matrix absorbed moisture from the oral environment, the sodium fluoride gradually dissolved and moved through the membrane into the saliva. This process was governed by Fick's first law of diffusion, which states that the movement of ions follows a concentration gradient. The copolymer membrane fluoride device was typically attached to the buccal surface of the first permanent molar using either stainless steel retainers spot-welded to orthodontic bands or by directly bonding the device to the tooth surface using adhesive resins. This approach made the device ideal for use in orthodontic patients or others at higher risk for tooth decay, as it provided localized fluoride treatment. The sustained-release nature of this

device marked a pioneering step in fluoride technology, helping to set the stage for future advances in fluoride delivery systems designed for long-term efficacy[6].

b) Glass Fluoride Devices (1980s):

In the 1980s, the glass fluoride device emerged as a novel innovation in fluoride delivery, particularly for orthodontic patients. These devices were designed to release fluoride slowly, helping to prevent dental decay around orthodontic brackets and wires, which are prone to plaque accumulation and can be difficult to clean properly. The glass fluoride device represented an advancement in fluoride delivery by offering a continuous release of fluoride, particularly in patients who may be at higher risk of cavities due to the presence of braces or other dental appliances.

DEVELOPMENT AND EVOLUTION OF THE GLASS FLUORIDE DEVICE:

The concept of the glass fluoride device was first introduced in 1984 by Curzon, in collaboration with the Department of Animal Physiology at Leeds University. Interestingly, this device was adapted from glass boluses—a device historically used in livestock management. These boluses were designed to gradually release trace minerals such as selenium, copper, and cobalt into animals' digestive tracts to prevent nutritional deficiencies, which are common in pasture-fed animals. Given the connection between certain trace elements and dental caries prevention, the concept of controlled release was adapted for human dental care to prevent tooth decay in orthodontic patients.

Curzon's modified version was intended to release fluoride slowly over time. The original design was dome-shaped, measuring 4 mm in diameter and 2 mm in thickness, and it was typically bonded to the buccal surface of the primary permanent molar using adhesive resins. However, one of the significant challenges of the early glass fluoride devices was retention. They were prone to dislodging, especially given the short-lived fluoride release, leading to limited efficacy over time[7].

IMPROVEMENTS AND MODIFICATIONS:

Recognizing these limitations, Curzon and colleagues at Leeds University made several modifications to improve both retention and fluoride release. The updated design was larger and more durable, with the device measuring 6 mm in length, 2.5 mm in width, and 2.3 mm in depth. These modifications resulted in a more effective fluoride release and enhanced retention, making the device much more reliable[8].

This revised glass fluoride device proved capable of releasing fluoride over a longer period, with some studies indicating it could remain effective for up to two years. According to Toumba and Curzon in 1993, the fluoride glass matrix would gradually dissolve upon exposure to moisture, providing sustained fluoride release while maintaining the structural integrity of the device. This development marked a significant improvement over previous designs, which often failed to maintain their fluoride-releasing capabilities for extended periods.

Clinical Findings and Effectiveness:

A pilot study conducted on the efficacy of slow-release glass devices reported promising results. The study monitored fluoride levels in saliva and gingival crevicular fluid over time. After three months of use, the fluoride concentration in saliva increased from 0.02 ± 0.04 ppm to 0.06 ± 0.12 ppm, and in gingival crevicular fluid, fluoride levels remained stable, with minimal variation from baseline. Importantly, the study found no adverse effects related to the use of the devices. Both the Löe Plaque Index and Gingival Index remained consistently low, suggesting that the fluoride release did not contribute to oral health issues such as plaque accumulation or gum inflammation. This further demonstrated the safety and effectiveness of fluoride glass devices in clinical practice[9].

c) Fluoride-Releasing Adhesive Systems (1990s–2000s):

During the 1990s, fluoride-releasing adhesive systems became more prominent. These systems incorporated fluoride into adhesive materials, which could be bonded directly to the tooth surface. This allowed for more consistent fluoride release over time. Fluoride-releasing orthodontic bands became widely used, particularly for patients with braces, as they provided targeted fluoride application in areas that are challenging to clean properly, such as around brackets and wires.

Additionally, fluoride-releasing composite resins and sealants were developed to provide long-term fluoride exposure at the site of application. These systems became an important preventive measure in orthodontics and restorative dentistry, as they helped reduce the risk of caries during orthodontic treatment[10].

RECENT ADVANCES: CONTROLLED RELEASE DEVICES AND NANO-TECHNOLOGIES:

In the past two decades, the emphasis has been

on refining fluoride delivery methods to increase efficacy and patient compliance.

Hydroxyapatite-Eudragit RS100 System (2000s):

The hydroxyapatite-Eudragit RS100 fluoride system presents a cutting-edge method in controlled fluoride release, aimed at enhancing dental health through improved remineralization and caries prevention. Hydroxyapatite (HA), a calcium phosphate mineral that is a primary component of tooth enamel, serves as a biocompatible carrier in this system. Eudragit RS100, a polymethacrylate polymer commonly used in drug delivery due to its ability to provide a controlled release profile, is combined with hydroxyapatite to create a composite that allows for sustained fluoride ion release over time[11]. The slow and continuous release of fluoride ions from this composite helps maintain fluoride availability on the enamel surface, simulating the natural remineralization process and potentially reducing caries progression by enhancing enamel resistance to acid attacks[12,13].

This method holds particular promise for pediatric and preventive dentistry, as children and adolescents are often more susceptible to caries and may benefit from prolonged fluoride exposure without requiring frequent applications. In clinical trials, the hydroxyapatite-Eudragit RS100 system demonstrated efficient fluoride release and an ability to remineralize demineralized enamel effectively, showing that it could be a viable alternative to conventional fluoride varnishes or gels[14]. Furthermore, the controlled-release aspect reduces the need for repeated fluoride applications, potentially improving compliance and accessibility, especially for individuals in areas with limited dental care resources[15].

Future research could focus on optimizing this system for various age groups, particularly within pediatric populations, and evaluating its long-term efficacy in reducing caries prevalence. If successful, the hydroxyapatite-Eudragit RS100 fluoride system could become a staple in preventive dentistry, delivering consistent fluoride levels for sustainable oral health benefits.

Smart Fluoride Devices and Personalized Medicine (2010s–Present):

Recent advancements in fluoride delivery are leveraging smart technology and personalized approaches to improve dental care outcomes. Innovations in nanotechnology and biomimetic materials aim to enhance fluoride retention on enamel, enabling a more efficient remineralization process. For example, nano-sized fluoride carriers can penetrate enamel microstructures more effectively than conventional methods, providing targeted fluoride delivery where it is most needed. Biomimetic materials, designed to mimic natural tooth structures, hold promise for improved fluoride integration and retention in enamel[16].

A particularly promising development is the emergence of "smart" fluoride delivery devices. These devices can respond dynamically to changes in the oral environment, such as shifts in pH, temperature, or salivary composition. For instance, when the oral pH drops, which indicates a higher risk for demineralization, these devices can increase fluoride release to help buffer the acidic environment and protect the enamel. This on-demand fluoride release aligns with the body's natural needs, making it both efficient and potentially less toxic than constant exposure[17].

Furthermore, the development of smart fluoride systems capable of interacting with oral microbiota opens up new possibilities for personalized medicine in dentistry. By tailoring fluoride release based on individual factors—such as oral bacterial composition or specific caries risk—these systems offer a targeted preventive approach, which is especially promising for high-risk populations or those with unique oral health needs[18].

CONCLUSION:

Fluoride devices have played a pivotal role in modern preventive dentistry, helping to significantly reduce the prevalence of dental caries. From the early days of fluoride water supplementation to the development of sophisticated fluoride-releasing devices, the innovations in fluoride application continue to shape oral health care. The future promises even more targeted and personalized fluoride delivery systems, with potential breakthroughs in nano-fluorides and biomimetic technologies. As fluoride technology continues to evolve, it will likely remain a cornerstone of preventive dentistry.

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Conflicts of Interest

There are no conflicts of interest.

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Case Report

Misdiagnosed Case of Adenomatoid Odontogenic Tumour in a Young Female

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ABSTRACT:

A misdiagnosed case of Adenomatoid Odontogenic Tumour (AOT) which is clinically and radiographically diagnosed but due to lack of proper knowledge of pedodontics the case had not been treated properly and the lesion had become aggressive. The purpose of this case is to represent clinical and radiographic findings of AOT for education purposes. It's a misdiagnosed case of AOT in a young female patient. Surgical excision was done in the present case and no reoccurrence was reported. The present case was misdiagnosed by a pedodontist. We suggest that the cases in which there is a suspicion of a bigger or more aggressive pathology the opinion of an oral radiologist and oral pathologist always should be sought.

KEYWORDS: Adenomatoid odontogenic tumor, CBCT in tumor diagnosis, Misdiagnosed case of the oral cavity.

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INTRODUCTION:

The adenomatoid odontogenic tumor (AOT) represents 3 to7 percent of all odontogenic tumors in the literature. It is not a very uncommon tumor that presents in the anterior maxilla and is common in females. The tumor is slow growing, benign, epithelial tumor with clinical presentation of absence or impacted teeth, absence of pain, expansion of bone, and deformity of the face as the lesion develops and grows. [1]

The term AOT was proposed by Philipsen and Brin in 1969 and accepted by the World Health Organization (WHO) in the same year. The WHO defines it as a tumor composed of odontogenic epithelium in a variety of histoarchitectural patterns, embedded in a mature connective tissue stroma and characterized by slow but progressive growth.[2]

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AOT exhibits duct-like structures and tubular characteristics microscopically similar to ameloblastoma which led to this lesion being designated as "adenoameloblastoma". The AOT represents a distinctive clinicopathologic profile, although not pathognomonic, is considerably different among other odontogenic tumors because most AOTs occur in association with an unerupted maxillary cuspid in teenage girls. The AOT appears in 3 clinical variants: follicular, extrafollicular, and peripheral type. [3]

We present a case that was misdiagnosed, despite of having a Cone Bean Computer Tomographic (CBCT) report. The tumor was diagnosed as AOT.

CASE REPORT:

A 15-year-old young female reported to the

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Figure 1: Intraoral Photograph.

Department of Oral Medicine & Radiology on 5th September 2022, with complaint of painless swelling in her maxillary anterior region in the second quadrant, involving the central incisor and lateral incisor teeth. Displacement of the lateral incisor was observed in intraoral examination. The swelling was present for 3 to 6 months and her main concern was regarding facial aesthetics and malaligned teeth.

On intraoral examination, the swelling measured 1.2 x 1 cm in size approximately with malpositioned central and lateral incisor in the second quadrant (Figure 1). We suspected the swelling had some unknown pathologic origin hence we advised the subject guardian's for CBCT.

Radiographic examination revealed a well-defined corticated, low-density cystic lesion in the left anterior maxillary region between teeth 21 and 22. The mixed cystic lesion was approximately 15.1 mm x 15.5 mm x 14.4 mm labiopalatally, mesiodistally and superioinferiorly respectively. The internal structure was composed of multiple small scattered calcifications resembling characteristic small pebble or snowflake appearance surrounded by a thick band/zone of radiolucency (Figure 2a & 2b). With these findings, radiographic diagnosis of AOT (Extra-follicular type) was given. The patient was advised to undergo surgical removal.

The patient went to a pedodontist for further treatment. The patient reported to us again after approximately 8 months with similar complaints of swelling in the left maxillary anterior region. On intraoral examination of swelling was of same size. In addition, the swelling became hard in consistency and non-compressible.

While looking at the severity of the case we again planned for CBCT imaging and while analyzing the 3D CBCT scan we saw that Root Canal Treatment (RCT) was done in the involved teeth. A well-defined, corticated, low-density cystic lesion was seen affecting the left anterior maxilla between teeth 21 and 22. The

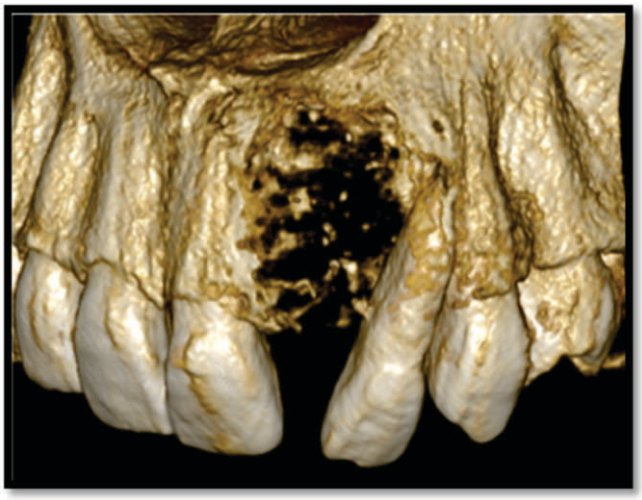

Figure 2a: 3D CBCT images – First scan.

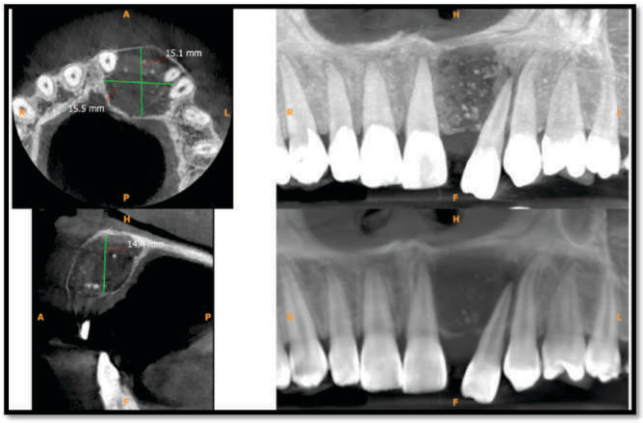

Figure 2b: CBCT Sections on the first visit – Mixed density lesion with multiple small scattered calcifications within an oval-shaped lesion resembling a "Snow-flake" appearance.

internal structure was similar to the previous CBCT. The adjoining labial and palatal bone cortices showed expansion and thinning. The endosteal margins of the bone cortices exhibited erosion.The mixed cystic lesion increased in size marginally (Figure 3a & 3b). After noting CBCT findings we again gave the diagnosis of AOT (Extra-follicular type).

To confirm our 3-D CBCT diagnosis, we planned for an Incisional Biopsy.

Histopathological findings revealed cystic tumour mass surrounded by thick connective tissue capsule. Predominantly cellular tumour mass consisted of spindle cells arranged in whorled mass, sheets and strands. Duct like structures were evident & lined by polarized columnar cells with nuclei away from the lumen. Hyaline rings surrounding the duct like structure and calcification were also seen. Rosettes of cells around a central space with or without eosinophilic material were noted (Figure 4). The

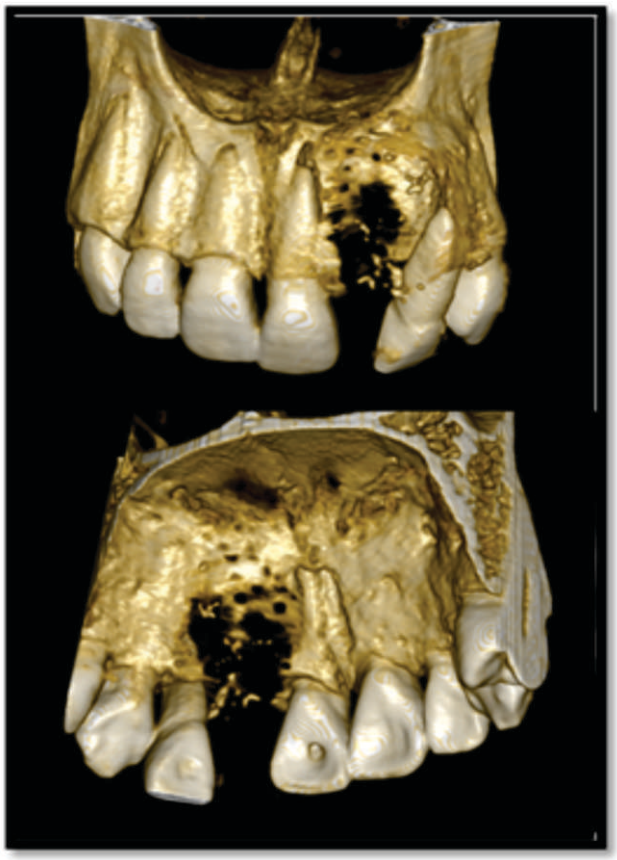

Figure 3a: 3D CBCT images – Second visit.

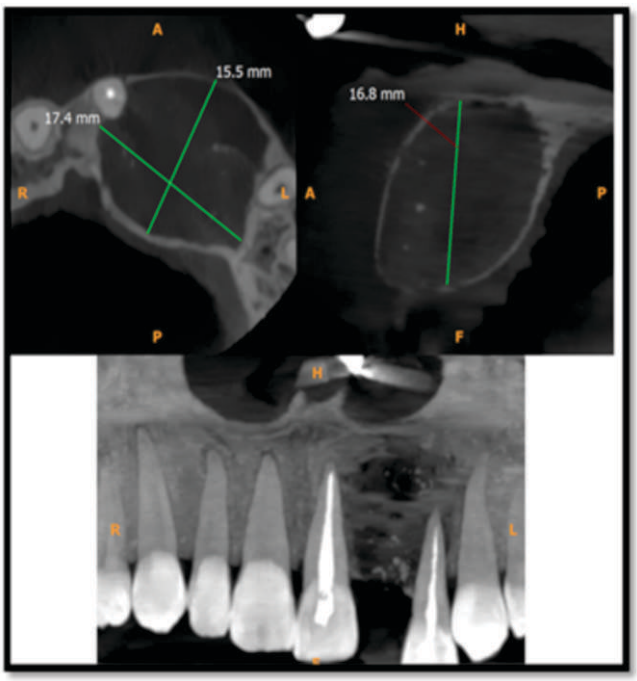

Figure 3b: CBCT Sections – Second visit; Significantly increased dimensions of the lesion were observed with thinning of the adjoining bone cortices.

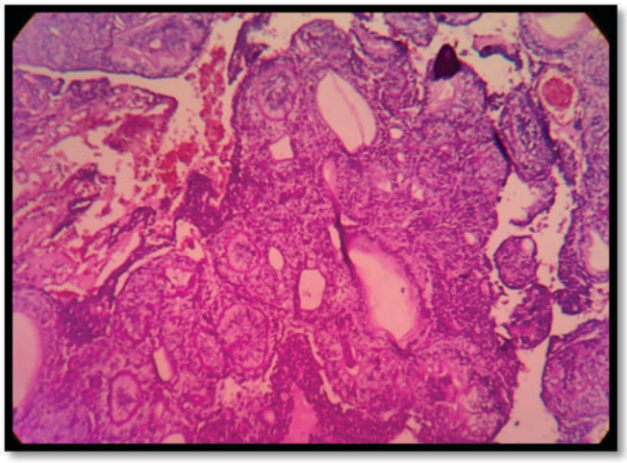

Figure 4: Hematoxylin & Eosin stained section.

diagnosis of AOT was confirmed.

DISCUSSION :

The AOT is a rare, benign, nonaggressive epithelial tumour that exhibits slow but progressive growth, derived from the epithelial component of the tooth-forming tissues, but none of the associated teeth were described as morphologically defective. Thus, the disturbance must occur after odontogenesis is complete.[1]

About 53% of AOTs occur in the anterior maxilla, and 9% occur in the maxillary premolar region. Only 2% of AOTs occur in the molar region. [4]

Radiographically, AOT has two variants, that is, follicular and extrafollicular type. In the present case, extrafollicular type is observed in CBCT imaging modalities. The extrafollicular variant is associated withthe rest of the dental lamina that remains in the bone after the development of the deciduous germ. [6]

Radiographically, the intraosseous variants share some features as well-defined radiolucency with small radiopacities, adjacent tooth displacement. The size usually is no more than 3 cm while root resorption and cortical perforation are rare.[7]

AOTs may occur anywhere within the jaw bones or the gingiva. Before the age of 30, nearly twice as many lesions are diagnosed in the maxilla, while after age 30, almost twice as many lesions are diagnosed in the mandible.[3]

The lesion is usually unilocular and radiolucent, containing fine calcifications (a feature that differentiates it from other lesions) which are well-demarcated with smooth cortical border. Displacement of neighbouring teeth is a more common finding compared to root resorptions. Approximately, 78% of adenomatoid odontogenic tumors show calcified

deposits and are associated with the crown of an unerupted permanent tooth in 71% of cases.[8]

Lesions of early age are generally regarded as hamartoma and those that occur later in life as tumors. Our case is in agreement with the tumor form, as it is seen in the second decade, and has presented with a well-formed tumor capsule.

The clinical presentation of AOT can simulate other common gingival enlargements which are reactive lesions or tumors and have to be considered in differential diagnosis. Pyogenic granuloma, peripheral ossifying fibroma, and peripheral giant cell granuloma are may be some of them.[9]

The treatment modality available for AOT is the complete surgical removal of the lesion. In the present case, we had advised for surgery and the case was transferred to the oral surgery department as it was misdiagnosed earlier.

Treatment consists of surgical enucleation and no recurrence has been reported even after incomplete removal, its main difference from ameloblastoma. Giansanti et al reported that the AOT was a completely benign tumor that never recurred once removed.[10]

CONCLUSION:

Today dental clinicians encounter various challenges in day-to-day practice but still, the key to correct treatment is the correct diagnosis. As a dental clinician it is our duty to serve for the benefit of the patient. If the case is not diagnosed by the first clinician, a second opinion gains importance. In the present case the correct diagnosis was made initially, but due to lack of knowledge and improper treatment planning the lesion became aggressive and increased in size. Hence it is always helpful to go for different diagnostic modalities starting from non-invasive to invasive which help in patient's proper treatment.

Financial Support and Sponsorship

Nil.

Conflicts of Interest

There are no conflicts of interest.

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Case Report

Endocrown: An Innovative Approach for Grossly Destructed Tooth

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ABSTRACT:

Endodontically treated molar rehabilitation is still difficult. The mechanical properties of molars are lost during endodontic treatment. As a result of the pulp and surrounding dentin tissues being removed, they become brittle. When repairing molars with significant coronal loss and endodontic treatment challenges, endocrown, a single partial restoration, may be an excellent option.

KEYWORDS: CAD-CAM, Dual cure resin, Endocrown

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INTRODUCTION:

Becoming hopeful about the rehabilitation of teeth with considerable coronal deterioration that have undergone endodontic treatment is still a significant difficulty for the majority of dentists. The biomechanical concepts of resistance and retention are often compromised.[1]

Clinicians arrange restorative treatments based on the extent of dental tissue loss and the biomechanical alterations brought about by root canal therapy.[2]A complete cast metal core supporting a crown has been recommended as a therapy for teeth severely affected by dental cavities or fractures.[3]

However, following the use of intraradicular posts, perforation and weakening of canal walls may occur as a result of excessive preparation.[4] Furthermore, dentists have been forced to consider other options such as the use of adhesive endodontic crown. This is due to limitations of using posts, which include calcification of root canals, limited canals, or fractured instrument.[5,6]

The term 'endocrown' refers to a single-piece ceramic structure that was introduced by Bindl and Mörmann in 1999 as an alternative to the whole crown supported by posts and cores. To increase macromechanical retention, this crown is affixed to the pulp chamber's interior walls and the hollow borders. Micromechanical retention is provided by adhesives.[7] We report a case that involved the restoration of a mandibular molar using a conservative and aesthetic posterior endodontic crown.

CASE REPORT:

An 18 year old female patient was referred to the Department of Conservative and Endodontics of our institute for the treatment of right mandibular first molar. Her first molar needed to be repaired since she had severe coronal damage.

After doing initial radiographic and clinical exams, chronic irreversible pulpitis was diagnosed. Endodontic treatment was planned. Rubber dam isolation was used to prepare the access cavity using an endodontic access bur size 2 (Dentsply-Sirona, Charlotte, North Carolina, United States). An endodontic explorer was used to examine the pulp chamber, and 10 K file (Mani, Inc; Tochigi, Japan) was used to traverse the canals . The Hyflex CM

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(Coletene) NiTi rotary device was used for cleaning and shaping the canals. Paper points were used to dry the canals, and bioceramic sealer (BioActive RCS, SafeEndo, Gujrat, India) was used for obturation. The patient's occlusion and oral hygiene was favorable. Considering the tooth structure that was still present and the wall thickness, an endocrown restoration was advised. The prosthetic decision to use lithium disilicate endocrown to reconstruct the tooth was considered.

Compared to a traditional full crown, the endocrown requires a different kind of preparation. To meet unique biomechanical requirements, this monolithic ceramic restoration needs to be prepared in a certain way.

In addition to creating a 'cervical sidewalk' in the shape of a butt joint, the objective was to decrease the occlusal surface's total height by at least 2 mm in an axial direction. The enamel walls that are smaller than 2 mm must be removed, and the cervical edge must be supragingival.

In order to provide the endodontic access cavity and coronal pulp chamber continuous, we used a 100% occlusal convergence cylindrical-conical diamond bur. It was possible to enter the pulpal canal. A maximum of 2 mm was achieved after the extraction of the gutta percha. We lined the root canal holes with glass ionomer cement to finish the preparation and seal the canal orifice.

Following an examination of the interocclusal space and the whole cavity, a silicone impression was made of the tooth utilizing the double imprint procedure. We chose the ceramic hue and submitted the imprint to the lab after visualizing and evaluating the impression quality. The endocrown was placed on the master cast after being made in a lab with CAD-CAM technology.

Next, we investigated proximal, internal, and occlusion modifications during an endocrown try-in. We immediately returned it to the lab so that the glaze and colorant could be applied. During the subsequent session, the endocrown's inside was cleaned with water, followed by drying the hydrofluoric acid-etched crown using an air syringe. The silane coupling agent was then applied, and it was allowed to dry for a minute.

After using a rubber dam to provide adequate isolation, the tooth surface was treated for 15 seconds on the dentin and 30 seconds on the enamel by phosphoric acid. It was then thoroughly cleaned and dried & adhesive was applied. Finally, 20 seconds of light curing polymerization was done.

The prosthetic endocrown was coated with a thin coating of a dual polymerizing resin, placed within the tooth and polymerized every five seconds, allowing extra cement to be easily removed. Following this, it was polymerized on all surfaces for 60 seconds. We looked for any occlusal interference with the restoration. The complete procedure is shown in Figure 1.

DISCUSSION:

A clinical problem in restorative dentistry is treating molars with a considerable coronal damage; this calls for cautious planning. For this reason, to ensure that the treatment is successful and that the molars will endure for a long time, the dentist must determine the best course of action.

The endocrown is beneficial for all molars, but is especially helpful for those having clinically low crowns, calcified canals, or tiny canals.[8] Nevertheless, it is not indicated if the cervical border is less than 2 mm broad across most of its circle, less than 3 mm in depth of the pulpal chamber, or if adhesion cannot be ensured.[9]

It has been demonstrated that the use of endocrown has advantages such as; it is simple to use, helps obtaining easy impressions, and safeguards the periodontium.[10] Furthermore, ceramic wear coefficients are comparable to those of real teeth, and their use offers the benefits of biocompatibility and biomimicry. Moreover, cohesiveness seems better due to the single interface of a one-piece repair. [11,12]

The preparation process aims to provide a broad, robust surface that is able to endure the compressive strains of the molars.[13]Proximal to the occlusal plane, the prepared surface provides stress resistance along the tooth's major axis.[14]

Compared to teeth with prosthetic crowns, teeth with endocrowns experience less stress. [15]The advent of adhesive cementation techniques has reduced the requirement for macroretentive crown preparation. [16]

Stability and retention are also provided by the pulpal chamber cavity. The maxillary molars have a triangular shape, whereas mandibular molars have a trapezoidal form which improve resolve the need for additional preparation and achieve restorative stability. The saddle-shaped construction of the pulpal floor increases stability. This layout and adhesive qualities of the bonding substance eliminate the need for extra post-involving root canal treatment.[14]

Research has demonstrated that endocrowns composed of ceramics based on lithium disilicate are among the best materials for restorative procedures due to their adhesive qualities, which also encourage resin cement micromechanical interlocking. [7]

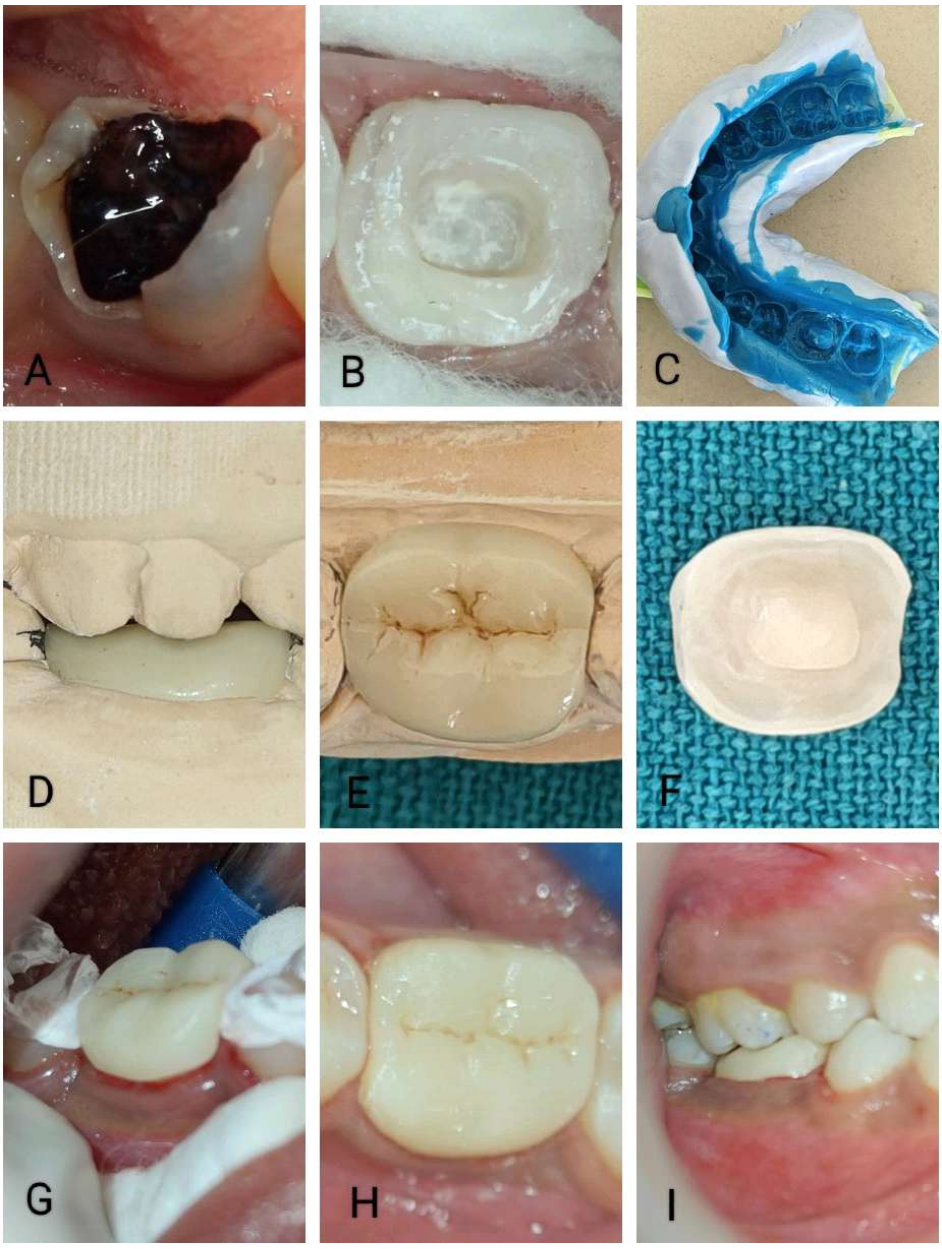

Figure 1: Endocrown preparation with respect to mandibular first molar (Right side).
A. Pre operative clinical photograph; B. Tooth preparation for endocrown; C. Impression after tooth preparation; D. Occlusion check on cast; E, F. Aspects of endocrown; G. Isolation of the adjacent tooth and placement of endocrown and H, I . Final views after placement of the endocrown.

According to Belleflamme et al, endocrowns may be a practical method for repairing severely injured premolars and molars, despite the possibility of substantial loss of coronal tissue or occlusal risk factors such bruxism or adverse occlusal connections. [17]

CONCLUSION:

For molars that have had endodontic treatment, the endocrown offers a highly promising treatment option since it preserves tooth structure, is consistent with the objective of minimally intervention dentistry and biointegration. For the mechanical and cosmetic repair of nonvital posterior teeth, it gives reasonable results.

Financial Support and Sponsorship

Nil.

Conflicts of Interest

There are no conflicts of interest.

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Case Report

Middle Mesial Canal: A Special Consideration for Mandibular Molars

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ABSTRACT:

Thorough debridement is required for the whole root canal system for successful endodontic therapy. One factor contributing to inadequate canal cleaning may be the complex root canal architecture.
The mandibular molars exhibit significant differences in terms of additional roots or canals. With the use of any magnification devices, the clinician should strive to locate every potential channel. The middle mesial canal changes in mandibular molars are covered in this report.

KEYWORDS: CBCT, Endotherapy, Middle mesial canal, Radiographs, Sodium hypochlorite

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INTRODUCTION:

Root canal therapy's main objective is to completely fill the pulp cavity with an inert filling material after thoroughly cleaning it mechanically and chemically.[1]

Clinically, a mandibular molar exhibits a wide range of morphological variations, such as, existence of C-shaped morphology of the canals, three canals, such as a middle mesial canal (MMC) or middle distal canal (MDC), additional roots in the mesial or distal root.[2-5]

One to fifteen percent of mandibular first molar mesial roots have an additional canal.[6]The MMC may be defined as a bleeding area that is present in the grooves that separate the mesiolingual (ML) and mesiobuccal (MB) canals. The size of the orifice is less than that of the additional canals.[3] Pomeranz et al in 1981, distinguished between three types of MMC: fin, confluent, and independent types.[2]

The MMC may combine with the Mesiobuccal or Mesiolingual canals in the centre of the root canal. The detection of this MMC requires advanced aids in order to reduce mistakes during the examination of canals, like cone beam computed tomography (CBCT), multiple radiographs, and additional magnification instruments such as magnifying loupes or dental operating microscopes.[7] We present 2 cases involving mandibular molars, each showing an MMC.

CASE REPORT 1:

A Twenty eight year old male patient complained of two weeks of pain and sensitivity in the area of his right lower back teeth. The clinical examination of 46 showed signs of dental structural loss along with discomfort on percussion and periapical palpation. A radiographic examination showed lost of dentin and enamel, as well as the existence of extra roots between the mesial and distal roots. Using clinical and radiographic data, dental caries accompanied by apical periodontitis was identified.

PROTOCOL FOR TREATMENT:

Before beginning therapy, the patient gave their informed permission. In order to provide inferior

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alveolar nerve block (IANB), 2% lignocaine hydrochloride with adrenaline was utilized (Lignox, Indoco Remedies Ltd, Mumbai, Maharashtra, India). An endodontic access cavity preparation with bur size-2 was used to construct the access cavity using rubber dam isolation (Dentsply-Sirona, Charlotte, North Carolina, United States).

An endodontic explorer was used to investigate the pulp chamber, and a 10 K file (Mani, Inc.; Tochigi, Japan) was used to traverse the canals. At first, two mesial and two distal canals were found. The area of bleeding was found to lie between the ML and MB orifices. In the end, five unique orifices were found: two distantly (distobuccal, distolingual) and three mesially (MB, middle mesial, ML).

Since every canal, including the MMC, was broad, the cleaning and shaping were done crown-down using the Hyflex CM NiTi rotary device (Coletene). RCT prep (Waldent innovations Pvt. Ltd, New Delhi) and 5.25% NaOCl (Prime Dental Products Private Limited, Thane, Maharastra, India) were used for irrigation. Paper points were used to dry the canals, and bioceramic sealer (BioActive RCS, SafeEndo, Gujrat, India) was used for obturation. The middle third region of the post-obturation radiograph showed that the MMC and MB canal had fused. A composite restoration (Beautiful II, Shofu Dental India Pvt. Ltd., New Delhi, India) was used to repair the access cavity as shown in Figure 1.

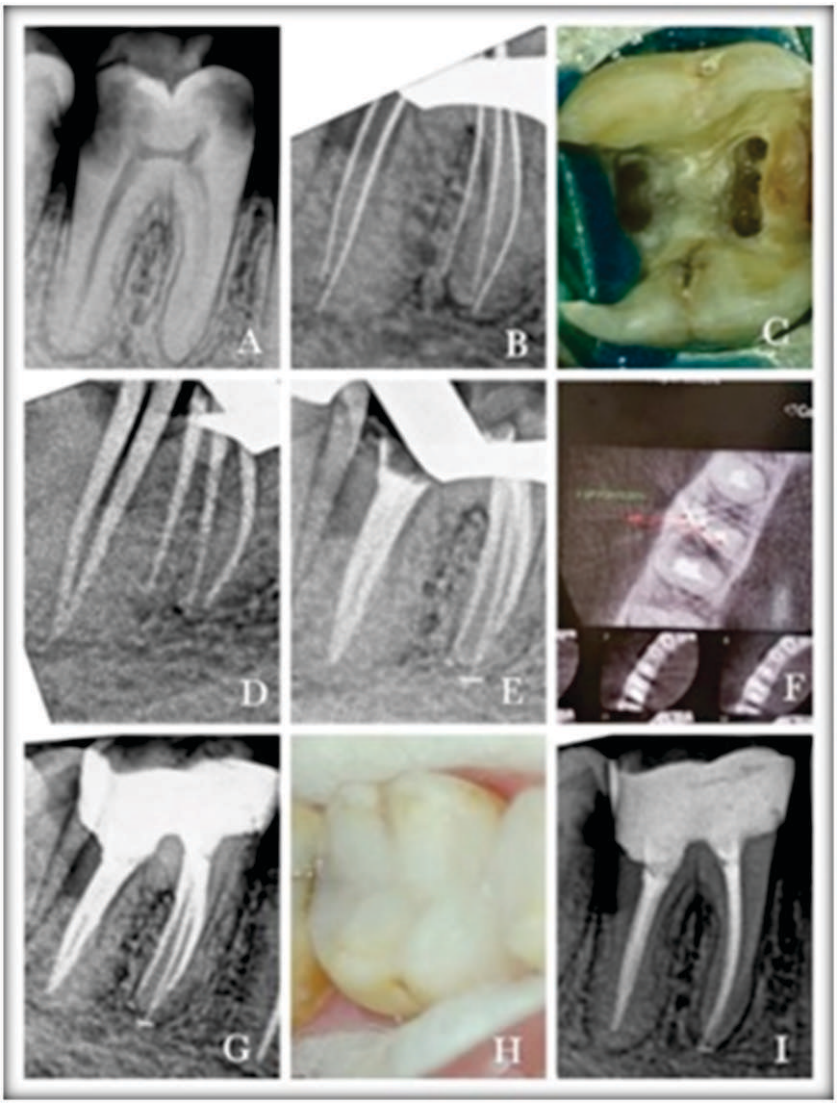

Figure 1: Middle mesial canal merged with mesiobuccal canal at the middle third region in 46
A. Pre operative radiograph; B. Working length determination; C. Clinical photograph showing 5 canal orifices; D. Master cone radiograph; E. Post obturation radiograph; F. post operative CBCT; G. Radiograph after post endodontic restoration; H. Clinical photograph after final restoration; I. Post Operative Radiograph

CASE REPORT 2:

A 30 year old male patient complained of pain in the lower back region of his left tooth.

Upon clinical examination, 36 had a class 2 deep carious lesion involving pulp and were percussion-tender. Patient gave non relevant history regarding medical conditions. Periodontal probing around the tooth revealed physiological limits, and the tooth were immobile. In the periapical region of the mesial root, there was a widening of the periodontal ligament gap in the vicinity of the pulp space, which was indicated by the preoperative diagnostic radiograph. The tooth was found to have apical periodontitis accompanied with symptomatic

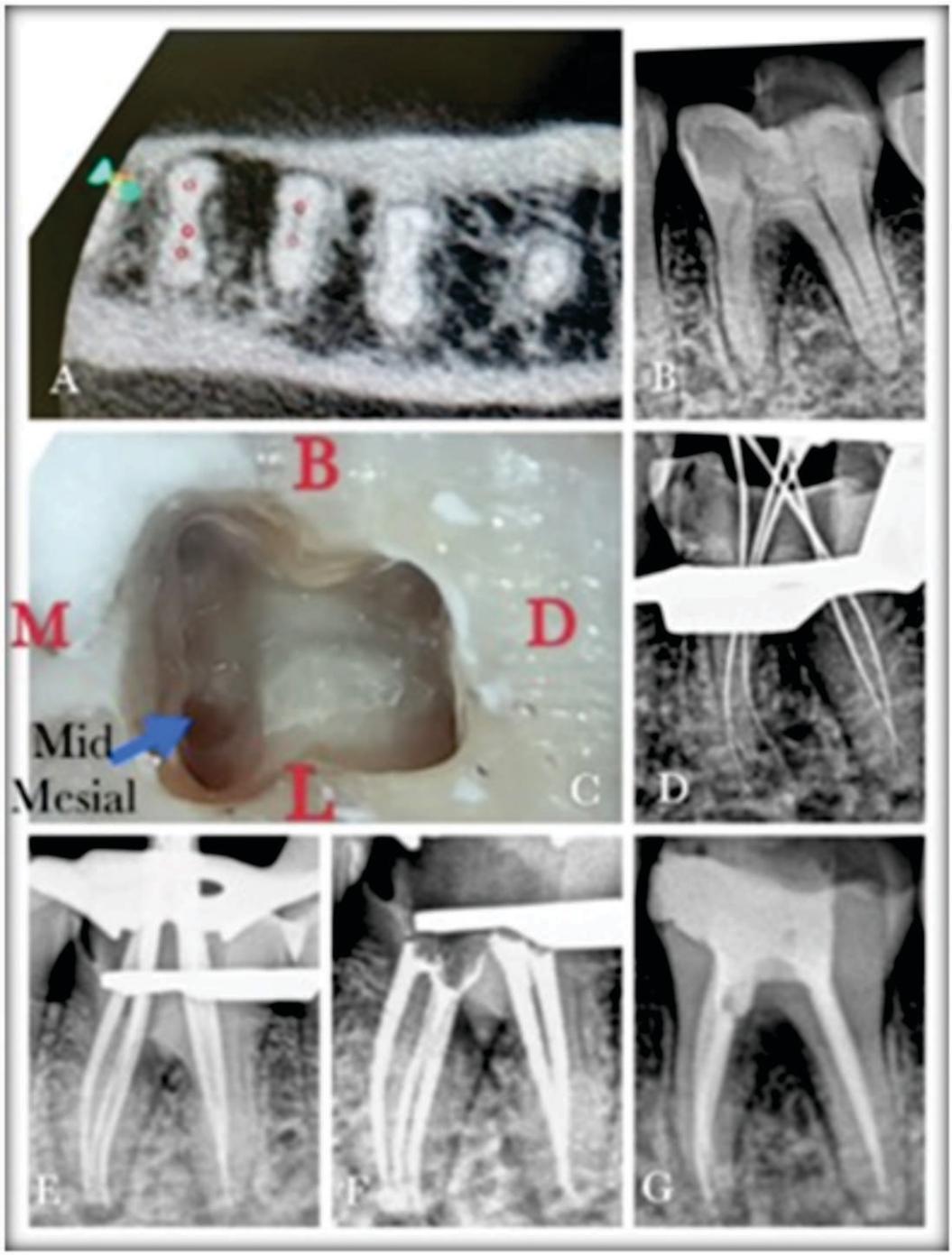

Figure 2: Independent middle mesial canal in 36
A. Pre-Operative CBCT showing 5 canals; B. Preoperative radiograph; C. Clinical photograph showing 5 canal orifices; D. Working length (WL) radiograph; E. Master cone; F. Post obturation; G. Post Operative radiograph

irreversible pulpits based on clinical and radiographic evidence. Endodontic therapy was recommended.

The tooth's radiographic examination revealed a typical root canal structure. The tooth was placed under rubber dam isolation for an endodontic access cavity preparation following local anaesthesia. Five separate orifices were found in this instance: two distally (distobuccal, distolingual) and three mesially (MB, MMC, ML).

To achieve straight-line access to all five canals, the traditional triangle access chamber was changed into a more trapezoidal shape. Using a Super Endo Blue Niti heat-treated controlled memory rotary file (Vasa Denticity Pvt. Ltd., New Delhi, India), cleaning and shaping was done following root canal scouting.

Radiological confirmation and determination of the working length were made. Normal Saline, 5.25% NaOCl (Prime Dental Product Pvt Ltd, Mumbai, India), and RCTprep (Waldent innovations Pvt. Ltd., New Delhi) were used for irrigation in between each instrument. Paper points were used to dry the canals, and bioceramic sealer (BioActive RCS, SafeEndo, Gujrat, India) was used for obturation. A radiograph taken after the obturation showed independent MMC. A composite restoration (Beautiful II, Shofu Dental India Pvt. Ltd., New Delhi, India) was used to repair the access cavity as shown in Figure 2.

DISCUSSION:

A multitude of writers have documented the presence of additional canals or roots in lower molars.[8,9] Angulated radiographs should be critically evaluated in order to assist the endodontic treatment. Variances in root canals are prevalent, and it is important for the dentist to recognize and treat these variances. Most mesial and distal roots are present in mandibular first molars; the canal distribution in these roots is typically 2 in the mesial root and 1 or 2 in the distal root. [10]

It has been observed that the MMC is seen in 1% to 15% of mandibular first molars in the mesial root. 3 canals in the distal root on the other hand, are unusual. [11]

It is more likely that there will be additional roots and canals:

1. If there is more bulbous root tip
2. If the lesion is positioned eccentrically,
3. If the canal vanishes quickly (Breakpoint)
4. If the file not be located in the root's centre
5. If there is enlarged periodontal ligament in the middle of the root (Ahmed, 2015). [13]

Seven different MMC were found clinically and on CBCT pictures, according to a recent publication, with an incidence rate of 13.725%.[13]

The endodontic therapy of a lower first molar with Middle mesial canals is described in this case report. According to Shahi S et al., the incidence of MMC in lower molars ranges from around 0.95% to 46.2%.[12]

The first reports of MMC were published in 1974 (Vertucci & Williams, 1974; Barker et al., 1974). Additionally, a thorough investigation determining the prevalence and clinical identification of MMC was published (Pomeranz et al., 1981). As a tooth develops, secondary dentin apposition occurs, creating a vertical split in the root that gives rise to the accessory canals (Srivastava et al., 2018).[13]

MMC is far more common in younger people and is present in all younger to middle-aged patients. According to Azim et al, there was very little difference in MMC incidence in mandibular first molars between genders or on the left and right sides. Nosrat et al. found even less.

Additionally, MMC incidence was bilateral according to (PertekHatipoğluet al., 2023). According to Solomonov et al, as people age, the possibility of finding these tiny auxiliary canals diminishes because they become more difficult to spot and identify due to obliteration caused by ongoing secondary dentin production.[13]

An independent canal, according to Pomeranz et al.'s categorization, suggests that it begins independently between the Mesiobuccal and Mesiolingual orifices and ends as a distinct foramen.[2]

The mesial roots in Case 1 contained canals classified as type XV by Sert and Bayirli[14], where the MMC connected to the mesiobuccal or mesiolingual canals middle section, correspondingly. In Case 2, each of the three canals terminated with a distinct foramen, and a distinct MMC identified 3-3 configuration of the Vertucci classification in the mesial root.[15]

In a 2016 study on the Indian population, Sherwani et al discovered that 67% of MMC orifices were located in the middle of the MB and ML orifice, 20% were closer to the ML canal, and 12% were closer to the MB canal.[16] Nosrat et al. reported that MMC was usually located nearer the ML orifice, with the middle region on the MB and ML orifices.[17] Toubes et al. concluded that, orifice was discovered independently between MB and ML (23%) and closer to MB (46%), with ML following (31%).[18]

Since the majority of MMCs are curved, tortuous, narrow, or attached to a primary root canal,

careful cleaning and shaping of these canals is necessary to prevent mistakes in the process (de Mattos et al., 2022). The appropriate rotary file selection, the right glide path preparation, and the right approach would effectively clean and shape without procedural mistakes.

When instrumenting the MMCs, constant taper rotary files [heat-treated] are always preferred (Kılıc¸ et al., 2021). It is important to consider the MMC arrangement while doing the apical enlargement. Due to the small minor diameter in these canals. It is usually preferable to prepare these canals to less tapered, lower diameters (preferably 4%). In order to shape and clean these auxiliary canals, crown-down instrumentation approach is recommended however, caution must be exercised during this process.[13]

Given the wide variation in mandibular molar morphology, a thorough study is essential.

CONCLUSION:

The secret to an effective endodontic treatment is having a thorough grasp of the intricate anatomy of the tooth. Canal preparation and obturation are more difficult due to the MMC's variable placement and configuration.

A successful course of therapy involves carefully interpreting the radiograph, using magnification, the newest equipment, following the right irrigation regimen, and sealing all the portals for microbial entry.

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Conflicts of Interest

There are no conflicts of interest.

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Case Report

Management of Extra Oral Sinus with Non-Surgical Endodontic intervention

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ABSTRACT:

Extra oral sinus tracts of endodontic origin clinically, might be mistaken with a variety of illnesses. Differential diagnosis of this clinical problem is critical in delivering proper clinical care because misdiagnosis may result in healing failure or needless medications. As a result, every cutaneous sinus tract involving the face or neck should be investigated for dental causes. Its diagnosis is not usually straightforward unless the treating clinician considers the possibility of a dental etiology. Once the accurate diagnosis has been made, definitive treatment, such as root canal therapy and tooth extraction, to remove the cause of infection is simple and successful.

KEYWORDS: Chronic periapical abscess, Extra oral draining sinus, Root canal therapy, Calcium hydroxide.

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INTRODUCTION:

The chronic apical abscess is an inflammation in the periapical area that eventually progresses and forms pus at the apices of the root. The sinus tract is a common finding since this lesion is symptomless. It is an indication of persistent infections of the dental tissue that allow infections and pus to drain. [1,2] The sinus tract follows the path of least resistance, which can appear either intraoral or extraoral. Factors that can determine the position of the sinus tract are the thickness of alveolar bone and overlying soft tissue, distance from the root apex, outer cortical bone, and shape of the bone.[3,4,5,6]The vestibule of the mouth along the buccal alveolar plate is the most common site for the emergence of the emergence of the sinus. [7]

Commonly, extra oral sinuses appear in various locations on the face.[8] Because of their resemblance to cutaneous lesions, we commonly encounter misdiagnosis and mismanagement. As this lesion appears on the skin's surface, it can be misdiagnosed due to absence of the dental symptoms for a variety of disorders, including topical cutaneous infections, growth hair, osteomyelitis, tuberculosis, actinomycosis, and congenital midline sinus of the upper lip.[8,9]

CASE REPORT:

A healthy young male patient aged 21 years old visited the Conservative and Endodontics department with a chief complaint of extraoral draining lesion located on the right side of the chin. On extraoral examination the lesion appeared to be of the size 2x2 cm located on the right side of the chin. He was very anxious and wanted to know the cause of the skin lesion present on his right cheek. During history taking, the patient revealed that the lesion has been present for 2 months, intermittently appearing and disappearing. Like any other disease that appeared on the skin would be treated, this patient was also treated by a general

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physician for several weeks with antibiotics. The type of pain was intermittent in nature; there was no history of night pain, and continuously, there was draining pus through the lesion. During the examination, a gutta percha of 25.4% was used to trace the sinus tract, which revealed that the culprit tooth was the lower right lateral incisor. While performing percussion tests, the tooth was slightly tender and painful, unresponsive to thermal and electric pulp vitality tests. After clinical and radiographic examination, a final diagnosis of periapical abscess and extraoral sinus tract associated with the lower right lateral incisor tooth was made.

Informed consent was obtained from the patient, after that, the tooth was root canal treated. 15 no. (Mani) K file was used, and two canals were negotiated. Working length was determined using an apex locator and a radiograph. Irrigation was done with saline coming out of extra oral sinus confirming the lesion was in the sinus tract with an odontogenic origin. As saline was coming out, extra orally chlorhexidine was preferred as an irrigant during cleaning and shaping of the canal due to the risk of apical extrusion of sodium hypochlorite (NaOCL) solution. Master apical file size of 20.4% was achieved using NeoEndo Flex files. A paper point of 20.4% to dry the canal, and intracanal calcium hydroxide was given for one week. After one week, calcium hydroxide was removed, and irrigation was done with NaOCL, which was left in the canal for 15 minutes to avoid extrusion that could occur due to irrigation. The canal was irrigated with saline, and the final rinse was carried out with chlorhexidine. To ensure complete disinfection, chlorhexidine was left in the canal for 10 minutes. The canal was dried and obturated with a single cone obturation technique using a bioceramic sealer. This was followed by temporary dressing. In third visit after removing the temporary dressing, Resin modified glass ionomer cement (RMGIC) followed by composite was used as a permanent restoration. At the 12-months follow up, clinically on the face area healing of the extra oral sinus was evident with nominal scarring. During radiographic examination after 1 year, healing of the periapical lesion was evident as shown in Figure 1.

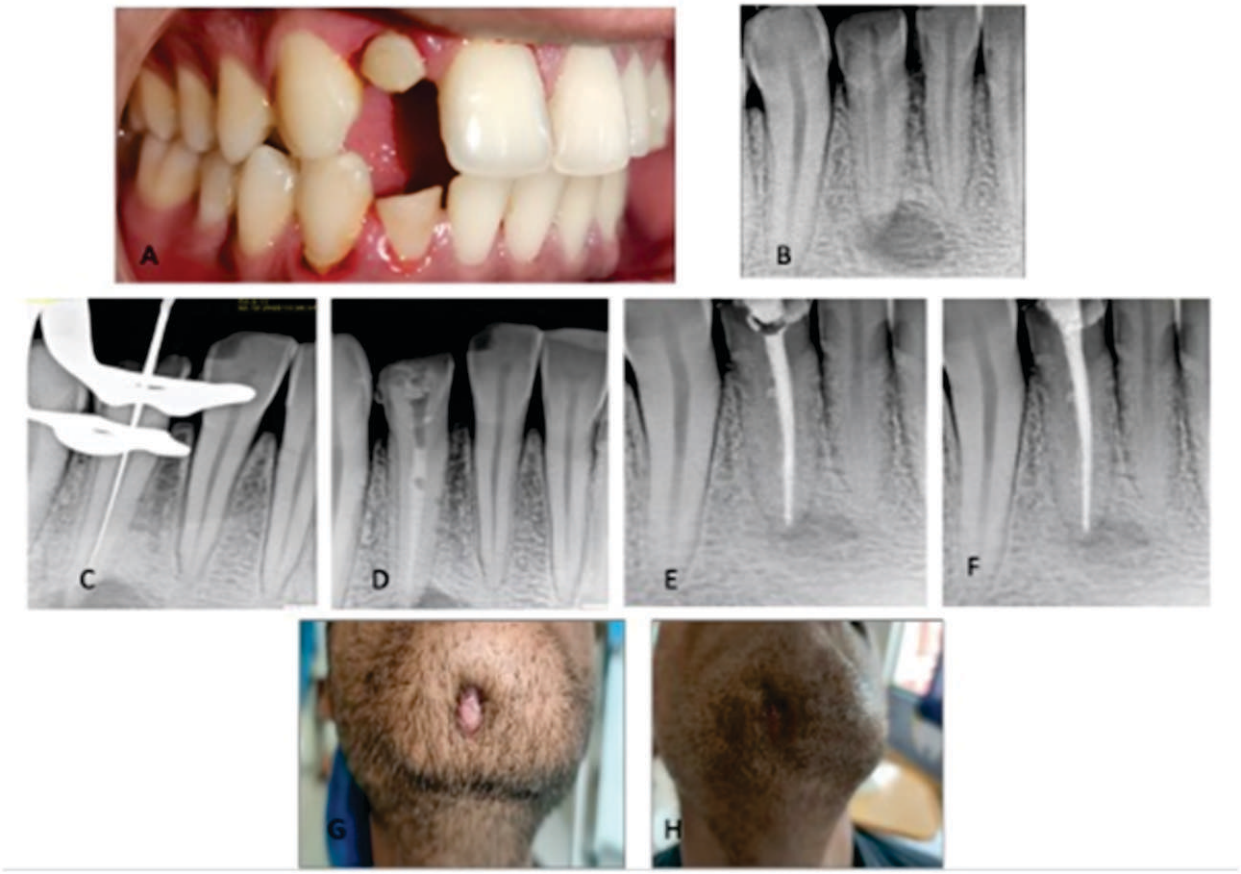

Figure 1 : Management of Extra Oral Sinus tract with NSET Figure Legend -
A. Preoperative clinical photo; B. Preoperative intraoral periapical radiograph; C. Radiographic working length determination; D. Calcium hydroxide placement; E. Post obturation radiograph; F. 12 weeks follow up radiograph; G. Pre operative extraoral radiograph; H. Healing of extraoral clinical photo showing extraoral healing

DISCUSSION:

Extra oral sinus tract is usually misdiagnosed, the reason being they mimic the cutaneous skin diseases. When diagnosing a discharging lesion in the region of the face or neck, a dental etiology needs to be considered as the most important factor.[10] Etiology for these lesion can be dental trauma, deep dentinal caries, periodontal problems, inadequate restorations, infection of the periapical area.[11] The recurring condition slowing advances through the alveolar bone, along the course of least resistance until it passes through the cortical plate of the jaws and produces a subperiosteal abscess.[12]When the apices of the teeth in the maxillary region has superior muscle attachments, and in the mandibular region has inferior muscle attachments there are far more probable chances of cutaneous sinus tract to occur.[13] There are 80% chances of draining mandibular abscess onto submandibular or chin region. Treatment modalities for an extra-oral sinus tract ranges from root canal therapy, endodontic mircrosurgery and extraction. As proven by the literature, non-surgical root canal therapy is the treatment of choice for the management of extra-oral sinus tract due to its non-invasive nature. [14,]A study conducted by Bodner et al evaluated the cosmetic results after treatment of extra oral sinus tracts[15]. 70% of the cases evaluated gave satisfactory results after non- surgical root canal therapy. Bradford et al also concluded that spontaneous closure of sinus tract should be expected after root canal therapy favoring this treatment modality[16].

CONCLUSION:

The extraoral sinus healed significantly, indicating that root canal therapy with antibacterial irrigants and after drying of the root canal placement of intracanal medicaments protocol is the preferred therapy in these cases. Initially, surgical intervention is not indicated of the involved teeth. Clinical observations indicate a reduction in inflammation and discharge, with the sinus gradually closing. The patient reported a decrease in pain and discomfort. Continued adherence to the prescribed treatment regimen and regular follow-up visits has been instrumental in achieving these positive outcomes. Overall, the prognosis for complete healing is favorable.

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Conflicts of Interest

There are no conflicts of interest.

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